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Applied Research Summary of Awards

Fiscal Year 1980

National Science Foundation
Directorate for Engineering and Applied Science
Division of Applied Research

Applied Research Summary of Awards

Fiscal Year 1980

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INTRODUCTION TO THE DIVISION OF APPLIED RESEARCH

This report describes the new awards made in Fiscal 1980 by the Division of Applied Research (DAR) in the Engineering and Applied Science Directorate (EAS).

The EAS Directorate supports research in Engineering and all fields of applied science. Within EAS, DAR supports research which provides an improved scientific understanding of a range of technical, social, economic and policy problems or which may increase the rate of technological innovation made possible by significant discoveries in various fields of science and engineering. A major objective of the Division is to be responsive to high quality applied scientific research proposals from the research performing community. During Fiscal 1980, the Division provided support to approximately one out of five of the unsolicited proposals which it received. Unsolicited proposals are accepted and reviewed in any field of science and engineering. However, projects requiring national security classification, providing technical assistance, developing commerical products, or of a clinical nature, or directly duplicating activities of other Federal agencies are generally not supported. Also, support is not normally provided for specialized facilities or research equipment except as part of a research proposals.

The Division of Applied Research has two sections: 1) Applied Social & Behavioral Sciences; and 2) Applied Physical, Mathematical, and Biological Sciences and Engineering. The Applied Social and Behavioral Sciences Section has four program elements: Public Policy and Regulation; Public Service Delivery and Urban Problems; Industrial Organizations and Markets; and Individual & Group Processes. The Applied Physical, Mathematical, Biological and Engineering Section has three program elements: Physical, Mathematical and Engineering Applications; Biological and Ecological Applications; and Geophysical and Environmental Applications.

Within some of the program elements of the Division, several "coherent areas" of research support provide funding for research on a programmatic basis. Current coherent areas are: Regulation; Growth, Income and Employment; Telecommunications; and Production Research and Technology. Coherent areas are created and phased out on the basis of developments in the fields in which they are grounded.

Proposals for research receive peer review from members of the scientific community, and from representatives of research user groups if the proposal emphasizes potential applications. Proposals are also reviewed by an Interdisciplinary Advisory Subcommittee which is made up of representatives of the applied sicence disciplines and user groups. The Interdisciplinary Advisory Subcommittees, one for each section, meet three times annually to review proposals and deliberate on DAR research directions. The advice of the Subcommittees played an important role in DAR decison-making. A list of Advisory Subcommittee members for 1980 follows this section.

The quantity and breadth of proposals received by DAR grew in 1980. While certain programmatic thrusts remained from previous NSF applied research programs, DAR's policy of providing an "open window" for unsolicited proposals expanded the range of subjects addressed in the proposals received. In addition, applied research proposals which do not find a home in other agencies or NSF divisions often find their way to DAR.

DAR also responds to Congressional legislation requiring the EAS Directorate to award a percentage of its budget to work performed by small businesses. Projects supported as part of the response to this requirement are listed below in a separate section.

In 1980, the DAR began an experimental research initiation program in the Applied Social Sciences. This program was created to provide an opportunity for young investigators (defined as those having earned the Ph.D. within the preceeding five years) to engage in applied research. This focus was designed to encourage younger scientists to extend their work in the direction of a number of significant social and economic problems and policy issues. A total of 167 proposals were received under this program, 34 awards were made by the Division. These are listed below in a separate section. Further information about the program is available from the Divison of Applied Research.

Division of Applied Research Statistical Profile

Since its inception in January, 1978, the Division has witnessed phenomenal growth in both the number and scientific variety of proposals received. Principal investigators from virtually every discipline have submitted proposals. While universities are the primary source, investigators at other types of institutions have also applied to the programs of the Division. These patterns are illustrated in Figures 1 through 4.

Figure 1 summarizes this growth. In FY 1978, the Division received 368 proposals requesting approximately $72.4 million. Using these figures as the base, in FY 1979 there was a 116% increase in proposals received and 25% in dollars requested. Approximately 33% more proposals were funded in 1979 than in 1978, for a one out of four success ratio. The budget request for the Division increased by about 10% as did actual obligations.

In FY 1980, proposal pressure continued to build. Proposals received increased over FY 79 by about another 42% and dollars requested by about 33%. Awards made increased by about 5.5% for a one out of five success ratio. The budget request to Congress for FY 80 decreased by 2% and, due to a deferral of funds in Spring of 1980, estimated actual obligations will shown early a 20% decrease. Under such circumstances, the average size of awards decreased substantially while their average durations increased somewhat.

The number of unsolicited proposals received by the Division has increased steadily as indicated in Figure 2. In addition, the number of proposals submitted in response to the Small Business Solicitation increased between 1979 and 1980. Finally, the program of Research Initiation for Young Investigators in the Applied Social and Behavioral Sciences attracted a sizeable increment of proposals in 1980 which is expected to grow in 1981.

Within this expanding base, a wide variety of disciplines are represented, as indicated in Figure 3. No one discipline dominates among unsolicited proposals, though Economics and Biology are the disciplines of principal investigators for 17% and 22% of the proposals respectively. The program of Research Initiation for Young Investigators in the Applied Social and Behavioral Sciences attracted the most proposals from psychologists, 27%, with economists and political scientists contributing 23% and 22% respectively. Under the Small Business Solicitation, approximately 42% of the applicants were in some field of Engineering, with Biology, Chemistry, Physics, Economics, and Psychology also represented.

In terms of institutional affiliation, as shown in Figure 4, 76% of applicants submitting unsolicited proposals were located at universities, with approximately 15% located at small businesses or non-profit research institutes. For the Research Initiation Program, which was aimed at young academic faculty, 93% of the applicants were located in universities and 7% in four year colleges.

FIGURE 1

Division of Applied Research Percentage Changes in Dollars Requested, Awards, and Budget

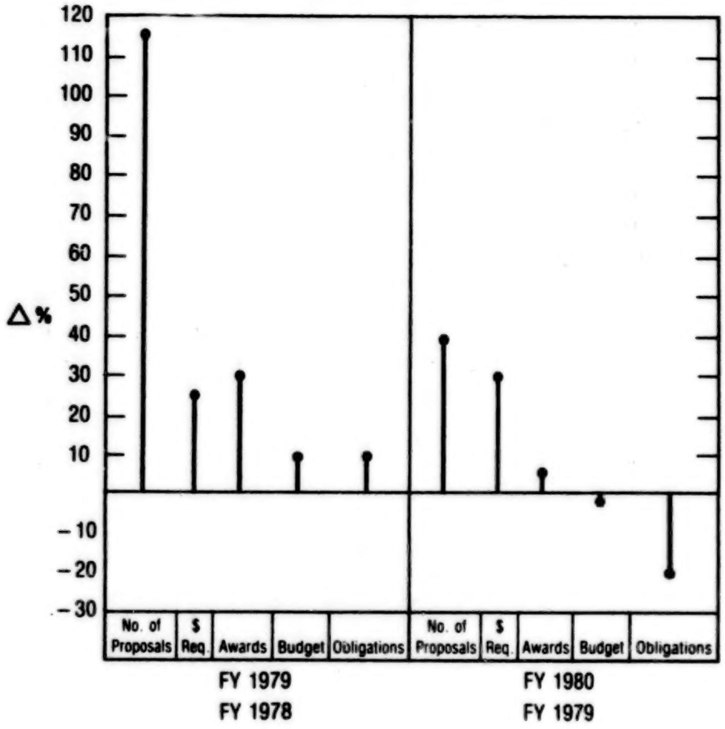

FIGURE 2

Division of Applied Research Proposal Mix

FY 1978-FY 1980 (EST.)

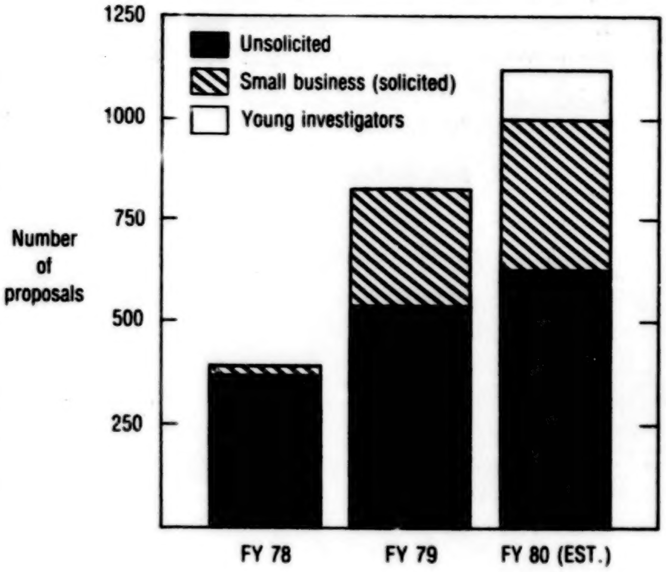

FIGURE 3

Discipline of Principal Investigator Proposals for New Starts FY 1980 (Est.)

	Unsolicited	Research Initiation	Small Bus.
Economics	17%	23%	1%
Engineering	12		42
Biology	22		10
Chemistry	10		11
Psychology	10	27	1
Political Sc.	5	22	
Sociology	3	8	
Physics	10		14
Other Social Sc.	7	20	4
Other Physical Sc.	4		17
Total	100	100	100

FIGURE 4

Institution Type Proposals for New Starts FY 1980 (Est.)

	Unsolicited	Research Initiation	Small Bus.
University	76%	93%	
4 Year College	4	7	
Small Business	6		100%
Non-Profit	8		
Other	6		
Total	100	100	100

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FY 1980

Division Director ....L. Vaughn Blankenship

Administrative Assistant ....Opal Fenwick

Systems Analyst ....Frederic J. Wendling

Professional Assistant ....David P. Chinitz

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Section Head for Applied Physical, Mathematical Biological Sciences, and Engineering ....Richard I. Schoen

Program Managers

Charles N. Brownstein	Telecommunications Policy
Josephine K. Doherty	Ecological Applications
Howard D. Greyber	Applied Physics
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John Kraft	Macroeconomics and Regulation
Trudi C. Miller	Public Management and Service Delivery
Tapan K. Mukherjee	Chemistry and Chemical Applications
Lynn Pollnow	Resource Economics
Laurence Rosenberg	Microeconomic Policy and Regulation
Kurt Salzinger	Applied Experimental Psychology
Richard I. Schoen	Production Research
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DEFINITIONS

The brief summaries which follow are provided for new projects funded by DAR in Fiscal Year 1979. Excluded are continuations and supplemental funding of existing awards; purchase orders, funds for personnel, and travel awards. An alphabetical listing of awards by Principal Investigator is included in Appendix A.

- "Award" refers to financial support given in the form of a grant, contract, or other arrangement, depending upon the nature of the research work to be completed and the terms of performance.
- "Effective Date" refers to the date specified in the award on which NSF funding becomes active (i.e., the date allowable costs may be charged against the award).
- "New" refers to an award which provides initial support for a project (i.e., has received no prior support from NSF), regardless of whether the principal investigator has received support on previous occasions.
- "Principal Investigator/Project Director" refers to the individual designated by the awardee (and approved by NSF) who is responsible for the scientific or technical direction of the project.
- "Institution" refers to any college, university, public or private laboratory, industry, or other organization, whether operating for profit or on a nonprofit basis, as well as State and local governments and Federal organizations.

Where awards have received support from other organizations within or outside of NSF, only Division suport has been indicated except where otherwise shown.

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APPLIED SOCIAL AND BEHAVIORAL SCIENCES

The Applied Social and Behavioral Sciences concern themselves with social, economic, and policy processes at the international, national, sectoral, community, organizational, and individual levels. Regulation, inflation, unemployment, international trade, and productivity are areas in which DAR has supported work. The behavior and productivity of private and public organizations is another area which receives considerable attention. In any of these areas a number of disciplines may play a role: economics, psychology, political science, law, finance, accounting, sociology, and operations research to name a few. Most applied social science projects involve several disciplines. For instance, in studying the behavior of service delivery organizations, attention might be given to economic, political, organizational, and legal factors, as well as to the behavior of the individuals involved in the processes under investigation.

Research in the applied social and behavioral sciences is closely coordinated with the work of other agencies through specially established review procedures. The Departments of Health, Education and Welfare; Housing and Urban Development; Agriculture, Commerce, and the National Institutes of Mental Health are some of the agencies which support research in fields related to work supported by the Division of Applied Research. On occasion, there may be joint funding and monitoring of awards. Performers of applied social and behavioral research are found in universities, industry, non-profit organizations and small business. University performers include not only investigators in traditional discipline-oriented departments, but also those in inter-disciplinary groups, professional schools, and university research centers. Proposals are received from individuals as well as groups of investigators. Since applied social and behavioral science research often involves original field work, large data bases, and significant computer time as well as costs associated with interaction with various "user" groups and the communication of study results to non-scientific audiences, the average costs on projects can be higher than they are for basic research in these fields.

PUBLIC POLICY AND REGULATION PROGRAM ELEMENT

This program element supports research which provides more and better information on policy issues of national concern. Policy oriented proposals from investigators in any of the social or behavioral sciences are eligible for consideration.

Approval Voting: Applied Research and Utilization; *Steven J. Brams,* New York University, Department of Politics, New York, NY 10003; $87,611 for 26 months beginning July 15, 1980.

Approval voting is a voting system in which a voter can vote for, or approve of, as many candidates as he wishes in a multicandidate election (more than two candidates). It has a number of striking advantages over present methods of electing candidates, including its practicability, which are summarized. Prospects for the adoption of approval voting in different jurisdictions are also discussed. In light of these prospects, and because the bulk of research on approval voting in the past few years has been mathematical and theoretical, the time now seems ripe to concentrate on more applied and empirical research. A program of empirical research is proposed, focusing on the historical reconstruction of elections under approval voting and other voting systems and on the analysis of contemporary survey-research data on approval voting and preference voting, to be collected in the 1980 National Election Study. A program of applied research is also outlined focusing on practical aspects of implementation and evaluation as well as the dissemination of information to practitioners to aid them in assessing the feasibility of approval voting. The proposed research will be strictly nonpartisan, and a careful attempt will be made to be as impartial and fair-minded as possible in comparing approval voting with other voting systems.

Hypermnesia and the Eyewitness; *Robert Buckhout,* City University of New York-Brooklyn College, Department of Psychology, Brooklyn, NY 11210; $106,366 for 24 months beginning August 15, 1980.

The main objective of the proposed research program is to investigate the use of hypnosis as a means of improving the level of accuracy in the reports of eyewitnesses to crime. A series of simulated crimes are exposed to witnesses in order to gather immediate recall data. The research paradigm is based on recent research on "hypermnesia" in which memory for images and pictures get better over time in apparent contradiction to the more common phenomenon of forgetting. Basing our research on recent breakthroughs in the laboratory and on the widespread interest and application of hypnosis in the interrogation of victims and witnesses to crime, an experimental comparison of hypnosis and other memory information is being generated as a basis for evaluating and employing hypnosis as an investigative tool.

Valuing the Health Effects of Air Pollution; *Maureen L. Cropper,* University of Maryland, College Park, Department of Economics, College Park, MD 20742; $43,803 for 12 months beginning August 1, 1980.

The research will measure the dollar amount an individual would pay for a decrease in air pollution by focusing on willingness to pay and on acute illness. The research differs in two ways from the conventional method of valuing air quality. The traditional approach calculates the effect of changes in pollution on life expectancy and then values changes in life expectancy using foregone earnings. This traditional method is likely to understate willingness to pay by ignoring the value of leisure time and by ignoring the health effects of pollution while the individual is alive.

To remedy these shortcomings this research will develop a model of acute illness which follows the human capital approach to health economics. The essence of the model is that the individual makes choices regarding his health, taking into account the health effects of pollution. The model will be used to define willingness to pay for a change in air quality and an equation suitable for estimating willingness to pay will be derived from the model. The model will thus provide a technique for valuing the acute health effects of air pollution.

Energy and Economic Growth in the United States and Japan; *Dale W. Jorgenson,* Harvard University, Energy and Environmental Policy Center, Cambridge, MA 02138; $85,195 for 12 months beginning July 15, 1980.

This is the first part of a continuing award to study the patterns of productivity growth in the U.S. and Japan, with special emphasis on the role of energy prices. The research builds on prior work dealing with productivity measurement and also develops new methods for understanding the determinants of economic growth and patterns of international trade during the post-World War II period. The research involves a large effort in data development and model construction. The study should yield insights useful for policy makers on the economic and trade performance of the U.S. in relation to our competitors and help us understand the impact of rising energy costs on trade.

Improving Jury Instructions; *Elizabeth F. Loftus,* University of Washington, Department of Psychology, Seattle, WA 98195; $156,357 for 24 months beginning September 1, 1980.

Previous research has shown that many jury instructions are difficult for jurors to comprehend, and result in faulty applications of law. This research focuses on a limited number of important standardized instructions such as those treating "reasonable doubt" and "intent." These instructions are particularly crucial in every jurisdiction because they touch on certain Federal Constitutional guarantees for trials. To test the operation of standard and revised jury charges, alternative formulations of selected instructions are prepared using inputs from both law and social science. Juror's ability to comprehend and apply the new instructions are tested in the context of concrete fact patterns, using real jurors in addition to members of the university community.

Evaluation of Telephone Conferencing to Conduct Motion Hearings in Civil Litigation; *Barry Mahoney,* Institute for Court Management, Denver, CO 80202; $29,880 for 10 months beginning April 15, 1980.

In the course of a civil trial many motions may be filed by counsel, necessitating appearances before the court. Some jurisdictions have begun to allow certain motions to be made over the telephone rather than by personal appearance. Questions have arisen as to the impact this technology may have on numerous facets of civil litigation. Of particular interest are questions of variance under the live and telephonic condition in frequency and disposition of motions, time required, cost and satisfaction. This research selects five specific courts with prototypical caseloads for case studies of telephone and live treatment of motion pleading. The research is intended to lead to a description of court experience with this phenomena and to a research design for empirically testing the variance in effects of live and telephonic motion pleading.

Use of Experts by Alabama Supreme Court; *F. E. McGovern,* Samford University, Cumberland School of Law, Birmingham, AL 35209; $130,000 for 24 months beginning October 1, 1980.

The role of appellate courts in reviewing decisions involving scientific and technical uncertainties and controversies has focused attention on the function of science and technology in the judicial process and the ability of appellate judges to assimilate, digest, and use technically complex material. This proposal outlines a plan for the implementation and study of procedures for the provision of scientific and technical expertise at the appellate level. The principal investigators, members of the Alabama Supreme Court, and other interested parties have agreed upon an acceptable procedural model for the provision of scientific and technical expertise at the appellate level in Alabama. The model would be available for replication in other jurisdictions.

The grant supports a quasi-experimental research design in which the presence of the scientist to the court is varied and judicial responses to scientific knowledge and material are measured. The treatment defines four types of cases and six observations of cases are made in each type group. Results should both test the methodology of the observation and yield insight into understanding the impact of a court's use of experts.

The Brookings Panel on Economic Activity; *George L. Perry,* Brookings Institution, Washington, DC 20036; $75,000 for 12 months beginning September 1, 1980.

This grant continues support for the research of the Brookings Panel on Economic Activity. The Brookings Panel was formed in 1970 to generate and publish high quality, timely and relevant research in response to changing developments in the economy. Although macroeconomic questions are emphasized, the research covers a wide range of topics where the issues studied are important enough to influence the overall inflation and unemployment rates. Under the previous NSF grant research covered such topics as trade deficits, exchange rates, tax-based income policies, state and local government surpluses, union wage determination, labor market dynamics, spending on consumer durables, investment, loanable-funds saving, price shocks, financial innovations, and monetary deceleration. Research topics change to reflect important issues and developments on the economic scene as they arise as well as significant, unsettled issues of economic analysis. Specific topics for research and presentation at the meetings of the Panel are agreed on through consultation between the authors and the directors of the Panel. The papers are edited to make the research results understandable to nonspecialist government, business and academic readers. The papers are published very rapidly in the *Brookings Papers on Economic Activity* so the research results will be available in a timely fashion.

The International Transmission of Inflation Through the World Monetary System; *Anna J. Schwartz,* National Bureau of Economic Research, New York, NY 10012; $120,873 for 18 months beginning March 15, 1980.

This project aims to produce a major National Bureau of Economic Research volume that will assess the empirical importance of the alternative channels by which inflation can be transmitted from country to country. In addition, the findings will serve as a basis for examining the implications of alternative international monetary arrangements for inflation in the United States and abroad.

The Application of Modern Statistical Principles to Automobile Insurance Risk Classification; *Herbert Weisberg,* Analysis & Inference Inc., Boston, MA 02109; $109,329 for 18 months beginning September 15, 1980.

Traditional approaches to risk classification represent the end result of an evolutionary series of developments. They are not based on an explicitly stated model or set of general estimation principles. Therefore, it is not clear whether they make optimal use of information on individuals in determining indicated insurance rates.

Although statistical methods represent powerful tools that have been applied successfully in many areas, their potential value for insurance has not yet been established.

The main purpose of this project will be to explore the usefulness of modern statistical methods by attempting to develop practical techniques for risk classification, and comparing these alternatives with traditional methods. The two specific objectives are:

- Testing the validity of traditional actuarial methods for risk classification
- Development and testing of alternative methods based on modern statistical principles.

In addition to improved methodology that can be used by insurance regulators to determine the adequacy of proposed rate structures, this research is expected to generate methods useful for other types of risk assessment analysis.

PUBLIC SERVICE DELIVERY AND URBAN PROBLEMS PROGRAM ELEMENT

This program element supports research on topics related to public organizations and organizational decision making, public service delivery, intergovernmental fiscal management, public finance, and urban development and planning.

Tracking the Intergovernmental Fiscal System; *Thomas J. Anton,* University of Michigan, Department of Urban & Regional Planning, Ann Arbor, MI 48109; $96,102 for 12 months beginning April 1, 1980.

Research findings will be useful in improving systems that record Federal expenditures in State and local jurisdictions. Federal data sources to be evaluated and compared for completeness and accuracy include OMB's "Federal Aid to State and Local Governments" (special analysis with the *Budget*), Treasury's *Federal Aid to States* and *Combined Statement,* various series of the U.S. Bureau of Census based on their five-year annual surveys of state and local governments, OMB's *Catalogue of Federal Domestic Assistance,* HEW's "Financial Assistance Reporting Systems (FARS)" and the Community Services Agency's "Federal Information Exchange Systems (FIXS)". Recommendations from the project would be aimed at improving FIXS, because it is the most comprehensive and detailed record, covering Federal program procurement, as well as grants-in-aid, for all counties and cities over 25,000.

Employee Reactions to Job Demands in Service Settings; *Sandra L. Kirmeyer,* Cornell University, Department of Organizational Behavior, Ithaca, NY 14850; $42,775 for 12 months beginning September 1, 1980.

The objective of this study is to examine the effects of work load (its volume and variability) on service employees' overload stress, actions taken to cope with overload, and on immediate consequences of the coping process. The conceptual framework of the proposed research is based on McGrath's (1976) cyclical model of organizational stress. A sample of 102 telecommunications workers is being intensively studied over time. A trained observer records the time of onset and termination of each communication transaction and of all other job activities on a portable electronic digital recorder. These time records are used to derive measures of the volume and variability of work demands. This research improves upon previous research by relating measures of objective and perceived load to hitherto little-studied employee behaviors as well as to attitudes. The behaviors measured include service strategies used by employees to reduce the number, scope, and duration of interactions with clients. Measured employee attitudes include overload stress and job challenge and involvement. Moreover, the research examines three variables which may moderate the effects of work load: skill variety, Type A behavior pattern, and higher-order need strength.

The Organization of Service Delivery: Recycling, Resource Recovery, and Solid Waste Disposal; *E. S. Savas,* Columbia University, Graduate School of Business, New York, NY 10027; $168,219 for 24 months beginning April 1, 1980.

The problems of environmental preservation, energy shortages, and solid waste disposal are posing policy issues for local government officials. They are faced with a multitude of conflicting and complementary choices in the area of recycling, resource recovery and waste disposal, at the same time that the public is demanding more efficient, effective, and responsive performance by government. Communities can address these problems by utilizing various combinations of source separation, separation collection of recyclables, voluntary or government-sponsored recycling and reclamation centers, "low technology" scavenging, "high technology" and ultimate disposal of landfills.

The proposed research will: (1) identify, and determine the extent of use of, organizational alternatives for recycling, resource recovery, and solid waste disposal; (2) evaluate the efficiency and effectiveness of the important alternatives; (3) evaluate the implementation process for the principal alternatives.

The research would make extensive use of available data, and be supplemented by telephone surveys and some on-site data collection to shed much-needed empirical light on the subject. Considerable emphasis will be placed on producing policy-relevant findings in a form that is useful to government decision-makers.

Private and Public Pensions; *John B. Shoven,* National Bureau of Economic Research, Cambridge, MA 02138; $124,763 for 12 months beginning October 1, 1980.

The NBER is beginning preliminary work on a broad range of economic aspects of public and private pensions. The topics being examined are the interplay of pension funding and corporate financial policy and the effect of pensions on total compensation and labor mobility. Other issues being explored are the effects of pensions on savings and capital formation and on retirement, the status and operation of state and local pensions, and the interplay of private pensions and social security. In addition, the study is identifying, reviewing and collecting all of the available data on pensions.

In addition, the researchers are involved in a NBER Summer Institute. This allows the researchers to assess priorities, exchange ideas, and plan future research.

INDUSTRIAL ORGANIZATIONS AND MARKETS PROGRAM ELEMENT

This program element supports research which improves understanding of industrial organizations and markets, managerial decision making, and work organization and performance.

Jobs, Firms and Industries: Economic "Dualism" and the Organization of Work; *William T. Bielby,* University of California-Santa Barbara, Social Process Research Institute, Santa Barbara, CA 93106; $77,441 for 12 months beginning April 15, 1980.

The research will examine relationships between attributes of firms and the characteristics of jobs within them. Variations in these relations across industries and "sectors" will also be studied in order to assess the validity of competing accounts of economic "dualism" and segmentation in the organization of work.

More specifically, job- and firm-level data collected since the late 1950's by the California Occupational Analysis Field Center for the U.S. Employment Service and statistical models (discriminant analysis, multivariate clustering, and scaling techniques, and structural equations) will be used to: (1) describe patterns of sectoral differentiation; (2) document variation between sectors in how tasks, promotion, and supervision are organized within firms; (3) assess the level(s) of social organization (job, firm, industry, and/or "sector") which most directly structure economic activity, and (4) link findings of industry structure to findings on industrial attainment.

Unions and Productivity in the Public Sector; *Ronald G. Ehrenberg,* Cornell University, Department of Economics, Ithaca, NY 14850; $50,455 for 18 months beginning September 1, 1980.

Research by economists on the economic effects of unions in the public sector has tended to focus on unions' effects on their members' relative earnings positions. In contrast, no research has been directed towards ascertaining the effects of unions on productivity in the public sector. Given the difficulties inherent in trying to define and measure output in the public sector, this latter fact is not completely surprising. Nevertheless, such studies are required to complete our understanding of the effects unions have had on municipal finances and service flows.

This project is studying the effects of unions on productivity in the public sector, focusing on elementary and high schools in New York State. The study employs a unique pooled cross-section time-series data base available at Cornell University and uses a "fixed-effects" error components econometric model. Public elementary and secondary schools are chosen for the pilot because of the relative ease of measuring output in education as compared to other public sector functions.

Empirical Analysis of Resource Scarcity and the Efficient Intertemporal Allocation of Exhaustible Resources; *Edgar L. Feige,* University of Wisconsin-Madison, Department of Economics, Madison, WI 53706; $86,842 for 15 months beginning June 1, 1980.

The fundamental principle underlying the economics of exhaustible resources is the theoretically established principle that the necessary condition for an efficient intertemporal allocation of a finite resource stock is that the price of the resource, net of extraction costs, should rise at a rate equal to the rate of return on alternative assets. This conceptual insight was clearly stated by Hotelling forty-five years ago, but has been subjected to only one empirical test in the intervening period.

This project is designed to start filling this gap in empirical knowledge by subjecting various implications of the Hotelling Principle to empirical tests on the basis of data set consisting of 100 years of data disaggregated by resource industry. The proposed research will focus on the following major issues: (1) How is growing resource scarcity to be defined and how can it be recognized before it has occurred? (2) Is the theoretically established necessary condition for efficient intertemporal resource allocation approximately satisfied by empirical observations and, if not, do departures from efficient price paths suggest that exhaustible resources have been depleted too quickly or too slowly? (3) How efficient are existing resource markets in utilizing available information?

Consumption, Retirement and Changing Life Expectancies; *Daniel S. Hamermesh,* National Bureau of Economic Research, Cambridge, MA 02138; $48,281 for 18 months beginning September 1, 1980.

This project examines the simultaneous determination of consumption and retirement decisions among older workers. Particular focus is given to the effect of heterogeneous and changing life expectancies on these decisions. Part of the work constructs a modified life-cycle model to imply these considerations. Most of the project is devoted to estimating the parameters affecting consumption and retirement in the Social Security Administration's Retirement History Survey. Data on the respondent's parents' longevity will also be used to test explicitly whether individuals' life expectancies affect the consumption and retirement choices that stem from their life-cycle decisions. The relation between retirement and parents' longevity will be replicated using data from the Terman sample of gifted individuals. The output of the project will be information on whether, and to what extent, we may expect recent increases in longevity to affect the retirement age, and thus how financially well off the aged population will be, and what its needs for income maintenance through Social Security and other retirement programs will be. As a by-product of the estimates we will be able to discover what percentage of older households are able to maintain consumption at the level consistent with *ex ante* lifetime maximation, and what fraction cannot because of inconsistent expectations about length of life.

Job Mobility and Youth Unemployment; *Christopher Winship,* National Opinion Research Center, Chicago, Il 60601; $105,863 for 24 months beginning April 1, 1980.

The purpose of the research is to investigate the nature and determinants of youth unemployment and job mobility. The research will evaluate the extent to which the higher rates of youth (as compared with adult) unemployment are the result of greater mobility of youth both into and out of the labor force and between jobs. The research will also examine the nature of mobility and the specific character of the states between which mobility takes place in more detail, the determinants of different types of mobility, and the consequences of that mobility.

The analysis will proceed under the assumption that mobility can be studied as a continuous time Markov process. Under this assumption instantaneous transition rates between various pairs of states of employment/unemployment and the effects of various variables in determining these rates will be estimated. The data used will be from January 1973 Current Population Survey and its supplement and from the Department of Labor National Longitudinal Studies of Young Men and Women.

INDIVIDUAL AND GROUP PROCESSES PROGRAM ELEMENT

This program element supports research which enhances understanding of socially significant behavior of individuals functioning alone or in groups.

Attitudes Determining Food Choices; *John E. Adams,* University of Minnesota at Duluth, Department of Geography, Duluth, MN 55812; $68,595 for 14 months beginning September 1, 1980.

The overriding aim of this research is to undertake a field investigation of fish consumption habits in the Caribbean, for the purpose of better understanding the nature and distribution of fish-eating behavior among the West Indians and their ways of evaluating the different kinds of seafood common to each place, culture, and socioeconomic group. The project attempts to: 1) investigate the West Indian attitudes toward fish as a food as opposed to other forms of meat, 2) make a cross-cultural and socio-economic study of fish preferences and prejudices for the various fish and fish products, and 3) examine the changes and trends in fish consumption habits. Unlike a marketing study, this project seeks to elucidate the psychological and socio-cultural factors that may affect fish consumption habits. The methods include on-the-spot investigation and mapping of fish markets, interviews with fish development personnel, nutritionists, and fish vendors, and the use of a fish opinion survey. Practical benefits of this project accrue mainly to development authorities concerned with increasing the consumption of locally-produced fish, while working within the sensitive framework of psychological and socio-cultural needs as investigated by this project. Hopefully, this project also makes a contribution to the better understanding of non-economic factors that affect the demand for seafood.

Long-term Effects of Early Intervention on Children; *Martin Deutsch,* New York University, Institute for Developmental Studies, New York, NY 10003; $108,843 for 21 months beginning January 1, 1980.

The purpose of this longitudinal investigation is to evaluate the long-range impact of early childhood intervention or education on later life adjustment. Standardized and newly constructed instruments will be administered to a sample of 200 young adults to assess their present intellective, social, emotional and achievement level. This sample of subjects will be drawn primarily from the participants in a New York University experiment to enrich the cognitive and socio-emotional experiences of preschool children from impoverished areas.

Data will be analyzed by multiple regression and multivariate analyses in order to determine the effects of early intervention on later development and to examine the interrelationship among cognitive, scholastic, and social orientation variables during early childhood and young adult years in this urban population. The results of this research investigation may provide a more solid foundation of knowledge and empirical evidence on which to debate and decide national policies with respect to children, families, education and intervention. Among other results, researchers may predict cost savings in programs to deal with delinquency and school problems of young adults as a result of early intervention.

Traits, States, and Life Events; *Barbara S. Dohrenwend,* Columbia University, Division of Sociomedical Sciences, New York, NY 10027; $97,402 for 24 months beginning October 1, 1980.

The general purpose of the proposed research is to determine the extent to which personal dispositions and social situations predict ways of coping with life events. Looked at in the context of psychological theory, the proposed research is designed to advance understanding of intrapsychic and environmental influences on behavior in complex, natural settings. It is also designed to provide understanding of coping behavior as a potential link in pathogenic stress processes. The ways of coping to be predited include perceptions of various dimensions of an event and actions related to the event. The personal dispositions to be studied as possible predictors of ways of coping are helplessness-control, repression-sensitization to threatening stimuli, and Type A coronary prone behavior. The social environmental situations to be studied as possible predictors are dimensions of the individual's social network such as size, density, and number of confidants. Hypotheses to be tested do not simply oppose personal dispositions to social environment situations but instead posit that each influencs behavior under specified conditions.

Socialization of Achieving Behavior in Men and Women; *Bernard Mausner,* Beaver College, Department of Psychology, Glenside, PA 19038; $149,724 for 36 months beginning September 1, 1980.

Avoidance of success is seen as a serious handicap to women as opportunities are widened under affirmative action. Although a tendency to avoid success may be derived from many sources, interactions between fathers and daughters in pre-adolescent and early adolescent years are proposed as a major factor. To study this, fathers and children, both girls and boys, will be videotaped as the father helps the child work through items from the Raven Matrices, a perceptual task. In addition, critical incident data concerning experiences of success and failure will be gathered. Analysis of videotaped interactions of critical incidents will be used to determine the factors affecting the child's values and expectations concerning success and failure. Categorizations of interactions will be related to the child's relative level of achievement during a subsequent period. It is hypothesized that fathers will be found to reward boys for success more intensely than girls, and to punish boys for failure. It is expected that girls will receive emotional support during failure. It is further hypothesized that support during failure and reward/punishment will be predictive of the child's achievement relative to ability.

A Technology for Increasing the Discriminability of Symbol Sets; *Mark S. Mayzner,* Loyola University of Chicago, Department of Psychology, Chicago, IL 60611; $150,000 for 36 months beginning May 1, 1980.

Though a major function of cathode ray tube (CRT) displays is to present symbolic information, no technology is available for generating maximally discriminable symbol sets. This project attempts to provide a quantitative guide for producing maximally discriminable symbol sets, no matter what their intended use, and a quantitative guide for repairing existing symbol sets with discriminability problems. The project includes: 1) a quantitative representation of symbols; 2) a model for determining the discriminability of symbol sets, and 3) a set of nine experiments for validating the usefulness of the model. The experiments employ the backward masking paradigm and the multiple random staircase method of experimental psychology. The project aims at providing a quantitative framework for developing more discriminable displays in the variety of settings in which CRTs are employed.

Kinematic and Kinetic Parameters as Information Feedback in Motor Skill Learning; *Karl M. Newell,* University of Illinois-Urbana, Institute for Child Behavior and Development, Urbana, IL 61801; $149,988 for 36 months beginning October 1, 1980.

This is a systematic investigation into the role of kinematic and kinetic parameters as forms of terminal feedback in motor skill learning. Traditional knowledge of results (KR) merely informs the performer about *what* happened relative to the outcome of the response without providing information about how the action was completed. Kinematic and kinetic information feedback about the response produced should facilitate initial acquisition and subsequent refining of response production. The experiments study various types of motor skills, e.g., movement outcome or movement pattern, and maximal performance skills vs. set criterion skills across actions with varying degrees of freedom for which these alternative forms of information feedback would be most useful. In addition, the experiments determine to what degree the skill level of the performer interacts with the most efficacious information feedback parameters. The findings have direct practical implications relative to the most appropriate form of kinematic and kinetic parameters as information feedback across various classes of motor skills, and theoretical implications relative to the movement cues picked by the performer for subsequent movement control.

Improving Acquisition and Memory in Young Children and Older Adults; *Eli Saltz,* Wayne State University, Department of Psychology, Detroit, MI 48202; $125,132 for 36 months beginning June 1, 1980.

Motoric enactment of meaningful sentences has been found to facilitate learning and memory for these sentences in both young children and in college students. Theoretical considerations lead to the expectation that the mechanisms producing these phenomena should be particularly effective for facilitating acquisition and retention of verbal information in some of the young, disadvantaged children who have severe academic problems acquiring verbal knowledge, and in older adults who are experiencing deficits in verbal memory. The proposed research was designed to test these predictions.

An Experimental Investigation of the Behavioral Teratogenic Effects of Exposure to Anticonvulsant Drugs; *Charles V. Vorhees,* Childrens Hospital Research Foundation, Cincinnati, OH 45201; $124,744 for 24 months beginning March 15, 1980.

Drugs taken during pregnancy pose a potential hazard to fetal development. In recognition of these potential teratogenic effects, regulations were adopted many years ago requiring new drugs to undergo extensive safety testing in animals prior to human use. These testing systems have generally been effective in detecting drugs causing physical malformations, but recently, a new group of drugs have been identified which, in human infants, produce primarily behavioral and other functional deficits rather than physical defects. These "behavioral" teratogens include prenatal exposure to high doses of alcohol, narcotics and anticonvulsant drugs. Animal test systems for drugs that may be behavioral teratogens are still being developed. The critical element in such screening procedures is test validity. The present study seeks to establish the validity of such a screening test system by modeling an instance of behavioral teratogenesis found in human infants, the anticonvulsant syndromes. The validity of a suggested animal screening system will be investigated by examining in the rat the postnatal behavior effects of prenatal exposure to phenobarbital, diphenylhydantoin and trimethadoine. Data relevant to human use, on the effects of these compounds will be analyzed by examining the relative magnitude of the defects they produce, their dose relationships, and the critical period(s) for the induction of behavioral teratogenesis.

APPLIED PHYSICAL, MATHEMATICAL, BIOLOGICAL SCIENCES AND ENGINEERING

The Applied Physical Sciences are concerned with developments in various fields of natural science and engineering which may lead to increased technological innovation and improvement in the breadth and quality of long range solutions to a wide variety of problems. The Division supports research in applied chemistry, physics, mathematics, geology, and biology, as well as in engineering.

Projects funded by the Division have been directed toward such areas as improved discovery and processing of mineral resources; developments in excavation technology; improved management of biological resources, both on land and in the oceans; and improved manufacturing processes. Some of the studies involve inter-disciplinary efforts. For example, research in excavation technology, which is concerned with developing more energy efficient and cost effective methods of mining by new or improved drilling, cutting and rock fracturing techniques, relies on recent advances in material science, rock mechanics, fracture dynamics and geophysics. Funding of applied research in the natural sciences must be closely coordinated with other government agencies such as the Departments of Agriculture, Defense, Interior, the National Institutes of Health, the Environmental Protection Agency, and the Department of Energy through specially established proposal review procedures. Performers of applied physical science research are found in universities, industry, small business and not-for-profit institutions.

PHYSICAL, MATHEMATICAL AND ENGINEERING APPLICATIONS PROGRAM ELEMENT

Research growing out of developments in the physical or mathematical sciences are supported in this program element.

New Families of Chromophores for Broad-Band Lasing Action, for Improved Long Wavelength Performance, and for Gas Phase Lasers; *George R. Bird,* Rutgers University, School of Chemistry, Piscataway, NJ 08854; **$179,680** for 36 months beginning April 1, 1980.

Dye lasers have become useful sources for tunable and highly monochromatic radiation. Although a large number of dyes are available for lasing action in the visible region, they operate over narrow bands and need relatively high threshold energies. Presently, there are no dyes capable of lasing in the gas phase beyond the visible blue-green region. In addition, the efficiencies of dye lasers are quite low and their operating lives are shortened due to photochemical degradation. The principal objective of this project is to synthesize and evaluate new families of dyes for superior laser action in the red and infrared regions. Possible solutions to the broad-band and gas laser problems will be investigated with cyclic merocyanine dyes. All the present infrared laser dyes apparently suffer from photoisomerization as a reaction competitive with laser action. This process leads to new chromophores which are Forster energy acceptors for the original material, thus strong quenchers. The acceptor-quencher behavior will be identified by monitoring both absorption and fluorescent yield during the life of the laser solution. The information will be utilized in the synthesis of photochemically stable laser dyes. Triplet-triplet (T-T) absorption commonly interferes with lasing action over an extended exciting pulse. Theoretical and experimental studies of T-T absorption will be carried out to find a method of shifting the interfering band out of the lasing region. Quantitative calculations will be performed on the qualitative "loop rule" for single-triplet intersystem crossing to clarify the start of triplet interference.

Extreme Impact Velocity Metal and Ceramic Deposition (Phase II); *James A. Browning,* Browning Engineering Corp., Hanover, NH 03755; $100,000 for 18 months beginning October 1, 1980.

The objective of this project is to determine whether superior coatings can be produced by using a specially designed plasma jet apparatus that combines the best attributes of plasma spray and flame jet techniques. In the phase I of research, an experimental annular flame jet accelerator was designed and tested with a variety of powdered and drawn wire materials. This accelerator raised the quality of coatings to that obtained using conventional plasma equipment. Present investigations are carried out at much greater combustion pressures than those studied in phase I. The research optimizes system performance of both oxy-fuel and plasma melted powder and wire feed equipment with emphasis on parameters controlling coating quality. Arc-melted single wire system is designed and tested.

An Investigation of an Improved Electrode (The Fluidized Bed Electrode) for the Production of Cobalt by Electrowinning; *James W. Evans,* University of California — Berkeley, Department of Materials Science and Mineral Engineering, Berkeley, CA 94720; $57,242 for 12 months beginning September 1, 1980.

This project is a continuation of an investigation on the use of fluidized bed electrode for the electrolytic production of cobalt (Grant DAR 77-24298). The objectives of this research are the determination of those process parameters which govern the performance of the fluidized bed electrode, as applied to cobalt eletrowinning, and the demonstration of the practicability of fluidized bed electrowinning of cobalt. Of major concern in this project is the reduction in electrical energy consumption in the electrowinning of cobalt. This is achieved by modification of a 1,000 amp. cell by incorporating energy saving ideas previously developed for copper electrowinning in a smaller cell. In addition, studies are conducted on the electrowinning from solutions containing both cobalt and other metal ions.

Mathematics Applied to Theoretical Physics, Engineering and Biology; *James Glimm,* Rockefeller University, Department of Mathematical Physics, New York, NY 10021; $50,000 for 24 months beginning September 1, 1980.

Nonlinear elliptic and hyperbolic equations will be investigated in both deterministic (classical) and stochastic (quantum mechanical) frameworks. The equations will be studied from both a theoretical and a computational point of view. Applications to theoretical physics (e.g. color gauge fields, quarks) and to engineering (unstable surfaces, heterogeneous and stochastic media, petroleum reservoir simulation) are contemplated.

High Speed UV and Electron Resist System; *Gershon M. Goldberg,* Ionomet Company, Brighton, MA 02135; $91,433 for 24 months beginning October 1, 1980.

The objective of this research program is to provide a two layer resist system, compatible with semiconductor substrates, that can be used to define submicron areas where various processing steps are to take place during the construction of microcircuits. The system consists of a very thin upper layer of high sensitivity to ultraviolet light, electrons, or other exposing radiation, and a relatively thicker lower layer which is in contact with the semiconductor surface. Transfer of the image formed in the high speed layer to the lower layer, preferably by a dry processing technique such as plasma etching, provides the pattern that protects areas of the substrate from the action of applied etches, ion implantation, or metal deposition. To construct such a system it is necessary to find inorganic or polymeric materials susceptible to plasma etching and compatible with an electron sensitive overlayer or inorganic material such as vapor deposited silver halide. This research fills a gap in existing efforts to extend the boundaries of integrated circuit technology to circuits with submicron feature areas. While present electron exposure devices are capable of providing the desired line width the low sensitivity of present organic resists limits throughput to the point where the overall process is of questionable economic feasibility.

Products of the Chlorination and Ozonolysis of Synthetic Dyes; *Joseph P. Gould,* Georgia Institute of Technology, School of Civil Engineering, Atlanta, GA 30332; $134,202 for 24 months beginning September 1, 1980.

The chemical oxidants, chlorine and ozone, have been used for many years as disinfectants. In addition, their ability to decolorize synthetic organic dyes has led to their consideration for the treatment of exhausted dye baths prior to discharge or recycle of the dye bath water and auxiliary chemicals. In both applications, the products of the reactions between the dyes and oxidants will reach the aquatic environment. The objective of this research will be to examine the reactions between the oxidants and several selected azo dyes and to apply novel and highly innovative mass spectrometric techniques to the characterization of the products of these reactions. The results of these studies will serve to elucidate the pathways of these oxidations and provide a measure of the value of the mass spectrometric techniques in the solution of this and similar environmental problems.

Picosecond Optical Signal Sampling Device; *Hermann A. Haus,* Massachusetts Institute of Technology, Department of Electrical Engineering & Computer Science, Cambridge, MA 02139; $38,500 for 12 months beginning September 1, 1980.

An optical sampling device is proposed based on the interferometric waveguide switch. The electrode structure is replaced by a traveling-wave or standing wave microwave structure to eliminate transit time effects. Four such interferometric devices in series driven at 10, 20, 40 and 80 GHz produce a periodic sampling function of 2 psec at full-width half-maximum The device would open up the possibility for the realization of picosecond sampling instruments. It may lay the foundation for compact picosecond optical instrumentation, which would be a great advance towards high speed optical data processing.

Evaluation of Mudflow Damages to Toutle River by Photogrammetry; *Michael C. Hou,* University of Washington, Department of Civil Engineering, Seattle, WA 98195; $10,114 for 6 months beginning July 1, 1980.

On May 18, 1980 a huge explosion from the top of Mt. St. Helens tossed up a towering wall of volcanic ash that darkened Eastern Washington, ignited scores of forest fires, and set off flash floods that routed hundreds from their homes, covered Spirit Lake, and continued onward into the valley of the North Fork of the Toutle River. Aerial photographs have been made of this disaster and seven targets have been placed on the peak of Mt. St. Helens to be used in the photogrammetric monitoring of this event. This project will provide photographs to be used for a precise photogrammetric survey to determine the total damages, depths of mud deposit, and process of erosion of the existing mud area of the Toutle River, as well as Swift Creek Reservoir, Yale Lake, and Merwin Lake south of Mt. St. Helens.

Kinsyn III-D; *Roger E. Kaufman,* George Washington University, Department of Engineering & Applied Science, Washington, DC 20052; $122,316 for 24 months beginning December 15, 1979.

A man-machine system is to be developed for the synthesis and analysis of spatial mechanisms. New mathematical formulations will be developed for basic kinematic properties of motion to permit real time manipulation and visualization of the design problem. Research will also be conducted on three-dimensional computer graphics as an aid to enhancing understanding of spatial relationships. New methodologies for man-machine interaction will be developed and explored to establish effective ways to visualize and design spatial kinematic hardware.

Growth of Laser Crystals by the Heat Exchanger Method; *Chandra P. Khattak,* Crystal Systems, Inc., Salem, MA 01970; $210,000 for 24 months beginning October 1, 1980.

Solid state lasers are presently being considered for laser fusion applications; however, large-size, uniformly doped crystals are not available. Ruby crystals are commercially grown in sizes up to 1 inch in diameter. Recently magnesium fluoride doped ruby has been identified as a prime solid state laser medium.

The objective of this project is to grow 3 inch diameter doped ruby crystals of highest quality with respect to uniformity of refractive index. Investigation is carried out on the basic understanding of dopant distribution in laser host crystals. The problems of volatilization, diffusion and segregation of dopant are being studied in order to establish crystal growth parameters. Lasing action of consistent quality crystals is evaluated at other facilities.

The project is Phase II of FY 79 Small Business Innovation Research Solicitation.

Nuclear Magnetic Resonance Microscopy; *Paul C. Lauterbur,* State University of New York—Stony Brook, Department of Chemistry, Long Island, NY 11794; $53,921 for 18 months beginning September 1, 1980.

This research project is in the area of nuclear magnetic resonance (NMR) imaging techniques. The basic aim is to extend the boundaries of this type of imaging towards the creation of a NMR microscope. Although resolution as good as the optical microscope is not anticipated, the ability to study the three dimensional structures of small opaque objects, and to employ a variety of chemical and physical differences to give contrast between structures, suggest that many useful applications will be found. Biological objects are an obvious possibility, including tissues, cells and small organisms.

The research includes: (a) a detailed theoretical analysis of the performance characteristics of NMR microscopes; (b) the construction of accessories, including specialized gradient coils, to make possible the use of standard NMR spectrometers at medium and high fields; and (c) the production of images with resolution between 10 um and 100 um.

Approximate Solution of Nonlinear Problems in Applied Mathematics; *Thomas J. Mahar,* Northwestern University, Department of Engineering Sciences & Applied Mathematics, Evanston, IL 60201; $16,259 for 36 months beginning June 15, 1980.

Several procedures for the approximate solution of nonlinear problems in applied mathematics are being studied. One area of investigation involves the application of asymptotic techniques to bifurcation phenomena in chemical kinetics, combustion theory and fluid mechanics. Discrete models of physical systems are being studied as alternatives to more classical continuous models. The qualitative properties of solutions to discrete and continuous models are being compared. A new approach to extremal eigenvalue problems is being pursued; a reasonably simple procedure for numerically computing solutions may result. Finally, the approximate solution of elliptic free boundary problems describing conduction and diffusion is being investigated. The existence of approximate solutions and their stability properties are being studied.

Fifth Sound Superfluid Gyroscope; *Julian D. Maynard,* Pennsylvania State University, Department of Physics, University Park, PA 16802; $134,000 for 36 months beginning March 1, 1980.

The superfluid gyroscope is based on the property of frictionless flow (superfluidity) of liquid helium when cooled below 2.172°K. The superfluid gyroscope described is based on an entirely different principle which gives the gyroscope greatly enhanced immunity to shock and vibration, and eliminates all drift and errors due to friction at high rotation rates and accelerations. Furthermore, the use of a recently discovered superfluid sound mode (fifth sound) in a Doppler rate detection technique will give this gyroscope a greatly enhanced sensitivity. Dr. Maynard will conduct the fundamental superfluid research necessary to determine the feasibility and characteristics of a fifth sound superfluid gyroscope.

Development of Fingerprints by Laser; *E. R. Menzel,* Texas Tech University, Department of Physics, Lubbock, TX 79409; $84,940 for 36 months beginning September 15, 1980.

This project deals with development of latent fingerprints by laser. The research falls into two categories:

1. Study of the feasibility of latent fingerprint age determination (at present not possible) through laser illumination and spectroscopic study of changes in inherent latent print luminescence with age and as a function of environmental conditions.
2. Development and optimization of latent print treatments leading to luminescence detectable by lasers. These treatments are designed to render prints visible when background luminescence precludes their laser detection by inherent luminescence, and to permit development of prints on difficult surfaces such as skin.

Microwave Signal Processing with Coherent Magnetic Waves; *Frederic R. Morgenthaler,* Massachusetts Institute of Technology, Department of Electrical Engineering & Computer Science, Cambridge, MA 02139; $118,883 for 36 months beginning September 15, 1980.

This is a three-year theoretical and experimental project aimed at developing coherent magnetic wave signal processing techniques for microwave energy in the 1-10 GHz range which may form the primary signal or else the intermediate frequency (IF) modulation of millimeter wavelength signals.

Emphasis is placed on developing new forms of linear and nonlinear signal processors that make use of magnetostatic waves propagating in high quality single crystal ferrite such as yttrium iron garnet (YIG). The focus is on novel guidance of magnetostatic waves and magnetic bubble-wave interactions.

Poroplastic Personnel Vapor Monitoring Badges; *Arthur S. Obermayer,* Moleculon Research Corp., Cambridge, MA 02142; $110,925 for 12 months beginning March 1, 1980.

Toxic vapors in the occupational environment pose a significant threat to workers. There is a need for a toxic vapor personnel monitoring badge for individual use which is convenient, rapid and specific in its response, easy to interpret, reliable, inexpensive, and capable of alerting a worker to a hazard at the time of exposure. Colorometric vapor-sensing badges represent a practical response to this need. This project employs transparent, liquid-impregnated Poroplastic film, which combines in one component the ability to acquire vapor, to conduct a colorometric reaction, and to display the resulting color. Earlier work under this contract developed systems for the detection of ammonia, hydrogen sulfide and chlorine vapors. Initial badge design has been completed. The objectives of the final phase of this project are to optimize the fabrication and performance of these three vapor monitors. In addition, the research will be extended to develop colorometric monitoring badges for nitrogen dioxide, carbon monoxide and formaldehyde.

Study of Family of Cr-free, Rust-resistant and Oxidation-resistant Steels; *W. Rostoker,* University of Illinois—Chicago Circle, Department of Materials Engineering, Chicago, IL 60680; $159,616 for 36 months beginning March 15, 1980.

Preliminary work has identified a family of chromium-free steels in the system Fe-Si-Mn-Ni-C which show a remarkable combination of fabricability, formability, strength, corrosion and oxidation resistance. The goal of this project is to establish a scientific basis which will provide information for optimum alloy compositions and processing conditions. Specifically, the research will include: (1) Analysis of phase equilibria and transformations in the composition regions providing predominantly austenitic structures; (2) analysis of the crack initiation characteristics of mixed austenite-ferrite structures, (3) analysis of the conditions of passivity and the nature of the passive films and, (4) a study of the high temperature reactions with aggressive gas components. Of particular interest is the function of silicon in film formation and the function of carbon in solid solution. The development of this family of structures prepares for the hazard of limited chromium supply from politically sensitive parts of the world.

A Mathematical Investigation of Reaction-Diffusion Systems Arising in Biology and Chemistry; *Sol I. Rubinow,* Cornell University, Graduate School of Medical Sciences, New York, NY; $41,670 for 36 months beginning May 1 1980.

Investigation of reaction-diffusion equation systems arising in four areas of biology and chemistry will be pursued. In particular, a model of the 'fast' transport system of proteins in the axons of neurons will be formulated, based on the concept that the proteins are transported by means of chemical association and dissociation to already moving microtubules. A dynamical continuum model of the behavior of slime mold amoebae in the morphogenetic development stage that follows slug formation will be examined. It assumes that the amoebae in contact can be represented as a viscous fluid subject to a body force dependent on the concentration of a chemical attractant. An investigation into the theory of Liesegang rings, based on a precise formulation of Ostwald's "supersaturation" mechanism will be continued. In it, the reaction terms needed to produce periodic precipitation zones are taken into account. Finally, investigation of some unresolved questions in facilitated diffusion arising in the solution of Wyman's equation will continue to be pursued.

Study of Homopolar Pulse Resistance Welding Parameters for Railroad Rails and Automotive Parts; *Henry G. Rylander,* University of Texas—Austin, Center for Electromechanics, Austin, TX 78712; $50,000 for 18 months beginning March 15, 1980.

Welding is one of the basic joining processes for metal fabrication and is vital to almost all industrial processes. Recent studies at the Univ. of Texas at Austin have shown that the very high current peaks of a homopolar generator can be harnessed for resistance welding. This megajoule (and gigajoule) pulsed power source provides the potential for resistance welding beyond current capabilities. This very high-current low-voltage generator makes it possible to resistance weld very large cross sectional areas and permits new design approaches to the fabrication of products.

The initial research that established the feasibility of using a homopolar generator for resistance welding was funded by the Division of Applied Research with a National Science Foundation Grant (DAR 77-23874). This research builds upon these previous results and is studying those variables for a welding process for industrial consideration.

The variables of the welding parameters for the joining of railroad rails and automotive components is being studied and used as examples to determine if the resultant process is industrially cost effective.

This Technology Innovation Project is being cost shared with the Federal Railroad Administration, the Association of American Railroads, General Motors Corporation, and Ford Motor Company.

Wear-out Failure of Mechanical Equipment Operation in Mt. St. Helens' Ash; *Gary L. Sheldon,* Washington State University, Department of Mechanical Engineering, Pullman, WA 99163; $7,500 for 12 months beginning June 15, 1980.

This study will survey the effects of ash from the Mt. St. Helens' eruption on wear-out failures of mechanical equipment operating in the Eastern Washington area. This project provides an opportunity to study wear failure under accelerated conditions and to determine possible remedial action for the benefit of all those operating mechanical equipment in the Eastern Washington area.

The Relationship Between Corrosion of Stainless Alloys and Electrochemical Measurements; *Michael A. Streicher,* University of Delaware, Department of Chemical Engineering, Newark, DE 19711; $25,000 for 12 months beginning July 1, 1980.

Electrochemical measurements are widely used in the study of general, pitting and intergranular attack on austenitic and ferritic stainless steels and nickel-base alloys. However, because of the incomplete understanding of the relationship of these measurements to corrosion processes, there is a need for further investigations in order to make effective use of the electrochemical data for the study of corrosion mechanisms, alloy development and the prediction of performance of alloys in plant service. This program is a study of (i) the time factor in potentiostatic measurements of pitting and intergranular attack; (ii) the differences between electrochemical, potentiostatic etching and simple immersion corrosion in detecting the presence of structural differences (carbide and nitride precipitates, intermetallic phases, submicroscopic units and equilibrium segregation); (iii) the use of polarization measurements for defining the direct and synergistic action of alloying elements, Cr, Ni, Mo, in providing resistance to general corrosion in oxidizing and reducing acids and chloride environments; and (iv) the factors in the corrosive solutions which determine the corrosion currents on specimens under potentiostatic control as compared with those which determine corrosion in simple immersion tests at the same time electrode potentials. This is the first year of a three year continuing grant.

A Study of the Structure Parameters on the Carbonaceous Mesophase Formation for Coke and Graphite; *Teh Fu Yen,* University of Southern California, Department of Engineering, Los Angeles, CA 90007; $150,000 for 36 months beginning September 1, 1980.

The aim of this research is to define the characteristics of coal precursors which will result in the best metallurgica cokes and to study the chemical changes occuring during the mesophase transformation in the coking process. Both model compounds and coal solvent fractions will be used as precursors. These will be pyrolysed and the resulting semi-cokes analysed. Analysis will be carried out using various analytical methods and hypothetical average molecular structures determined for the precursors and the pyrolysis product. The pyrolysis residues will be examined optically to determine the microstructure. Semi-cokes will be further heated to form cokes and the properties of the cokes correlated with the properties of the semi-coke and the precursors. By understanding the effects of molecular structure on mesaphase formation it will be possible to tailor the composition of the precursor materials for control of the properties of the metallurgical cokes produced.

BIOLOGICAL AND ECOLOGICAL APPLICATIONS PROGRAM ELEMENT

This program element suports research which increases the rate of technological innovation growing out of discoveries in the biological and ecological sciences.

Breeding and Utilization of the Buffalo Gourd; *William P. Bemis,* University of Arizona, Department of Plant Sciences, Tucson, AZ 85721; $149,738 for 24 months beginning October 1, 1980.

This renewal covers the fourth and fifth years of the domestication and utilization of the Buffalo Gourd, (Cucurbita foetiodissima) supported earlier by NSF 76-82387. Field studies include increasing seed from germplasm nurseries for long term shortage and phasing out of the germplasm nurseries. Breeding and genetic studies are directed toward the improvement of hybrids with respect to quantitative and qualitative yield components. A complete yield profile for each experimental hybrid is being established and statistically compared. Methods of eradication of plantings have been initiated. Consumptive use of water is being determined. Disease reaction, salt tolerance, and interplant competition (population density) are being studied as they effect yields. Lipoxidase enzyme activity is being determined and related to genetic background, seed maturity and conditions likely to promote enzyme action. Isolation, determination of properties and nutritional evaluation of a protein isolate from seed embryo are being carried out. Determination is being made of the influence of genetic background on starch properties particularly rheological behavior. The properties of the starch are being altered by modification in order to explore additional utility in food applications. The effectiveness of buffalo gourd starch as an alcoholic fermentation substrate is under study with respect to substrate isolation, product composition, effect of an amylase which may be present, and the suitability of the residue for reminant feed. Silage is being prepared from vines and pepo residue. Seed coats and silage products are being nutritionally evaluated in ruminant animals where sufficient material is available.

The Effect of Volcanic Ash from Mt. St. Helens on the Aquatic Ecosystem (Benthic Invertebrates) of the Palouse River; *John B. Conway,* Washington State University, Department of Bacteriology & Public Health, Pullman, WA 99163; $7,500 for 12 months beginning June 15, 1980.

The opportunity exists to study the impact of a natural environmental disaster, ash fallout from the Mt. St. Helens volcano on the ecology of an aquatic ecosystem. One way to carry out this sort of investigation is to do a biological survey. A biological stream survey is a study of stream conditions as they affect the growth and production of biological life within a stream.

Background information does exist on the number and diversity of benthic invertebrates in the Palouse River drainage basin. An investigation of the water quality of the river including the benthic organisms was completed in 1973. The State of Washington Department of Ecology assessed the water quality on a portion of the basin in 1979.

The objective of the proposed investigation is to evaluate the effect of the volcanic ash on the water quality of the Palouse River and specifically the aquatic eco-system using numbers and diversity of benthic invertebrates. Other parameters under evaluation include: water temperature, pH, dissolved oxygen, turbidity (ppmm SiO_2) and total coliform bacteria (membrane filter method).

A Comparison of Herbivore, Predator and Parasite Adaptations to Toxins; *Brian A. Croft,* Michigan State University, Department of Entomology, East Lansing, MI 48824; $100,000 for 24 months beginning November 1, 1980.

The objectives of this study is to compare sensitivities of herbivorous mites and their mite predators to various pesticides and plant toxins.

Dietary exposure of the plant eaters to high concentrations of plant compounds suggests some preadaptation to pesticide detoxification perhaps via evolution of necessary enzymes. The activities of two groups of detoxification enzymes are being compared: the microsomal mixed function oxidases and the carboxylesterases. Feeding tests are underway to determine of the concentration if plant toxins in the diet increases the activity of the detoxifying enzymes, and/or tolerance to pesticides. Toxicity tests and enzyme assays are being performed with a few key compounds on a variety of herbivore-predator-parasite complexes. The methods in use involve the topical application of the toxins combined with permeability tests to compare penetration of radioactively labelled compounds (alkaloids, phenols, glucosinolates, organophosphates, carbamates, pyrethroids, and one of the formamidines). This research will increase our understanding of predator-prey and plant-herbivore coevolution, and insect toxicology. The research will also be useful for biological control programs in agriculture.

Vulnerability of Florida Watersheds to Riparian Disturbance; *Edward S. Deevey,* University of Florida, Department of Zoology, Gainesville, FL 32601; $160,222 for 24 months beginning March 15, 1980.

Attempts are being made (1) to devise several sedimentary indices of rate of change of trophic state, and (2) to evaluate the indices, with special attention (a) to modes and magnitudes of existing disturbance, and (b) to coping capacities of receiving lakes, as predictive measures of an ecosystem's vulnerability to urban impact. Paleolimnological techniques are being used to find, in dated sediment cores, biogeochemical indices that measure recent rates of change of trophic state of several study lakes. Present trophic state, and material inputs associated with measureable differences in riparian land use, are also being estimated. As residence time may be the most important capacity factor, emphasis is being placed on a number of more and less disturbed drainage and seepage lakes. When the independent variables (present trophic state, disturbance, and capacity for response) have been quantified and realistically arrayed, indices to the dependent variable (rate of change of trophic state) can be evaluated statistically and built into a predictive model.

In Vitro Biosynthesis of Penicillin and Cephalosporin Antibiotics; *Arnold L. Demain,* Massachusetts Institute of Technology, Department of Nutrition & Food Science, Cambridge, MA 02139; $210,490 for 36 months beginning April 1, 1980.

The investigator has achieved a breakthrough in the *in vitro* enzymatic synthesis of the penicillin and cephalosporin antibiotics. Cell-free preparations of the fungus, *Cephalosporium acremonium,* were used to achieve formation of the ring structure of isopenicillin N from the tripeptide S-(L-α-aminoadipyl-L-cysteinyl-D-valine) and the expansion of the penicillin N ring to deacetoxycephalosporin C. Rapid chemicals assays will be developed for these two reactions. The enzymes will be purified and the effects of the amino acid methionine and the sugar glucose on the synthesis and activity of the enzymes determined. Potential antibiotic intermediates and synthetic precursor analogs will be tested. It is hoped that this study will elucidate the biosynthetic pathway to and the mechanisms regulating the biosynthesis of the β-lactam antibiotics such as penicillin, and possibly lead to the synthesis of new and useful β-lactam antibiotics.

Acute Effects of Inhalation of Volcano Dust in the Canine Model; *Robert L. Hamlin,* Ohio State University, Research Foundation, Columbus OH 43210; $10,000 for 12 months beginning August 1, 1980.

The purpose of this project is to study the acute effects on the respiratory system of the inhalation of particulate matter from the Mt. St. Helens volcano. A canine subject under general anesthesia is forced to inhale on 5 successive inspirations an aerosolized mixture of 10,000 to 20,000 ppm of volcano dust using negative pressure plethysmography. Each subject has complete pulmonary mechanics study performed prior to inhalation and at 4 weekly intervals post inhalation using positive pressure plethysmography. Study of the acute changes in dynamic compliance and resistance as well as alterations in flow characteristic at varying lung volumes provide an immediate evaluation of the hazards to humans as well as other infrahuman mammals exposed to dust from volcanos. The changes in pulmonary function are correlated with both gross and histological changes in the lungs at 4 weeks post exposure.

Warmwater Streams Symposium; *Melvin T. Huish,* American Fisheries Society, Warmwater Streams Committee, Raleigh, NC 27611; $5,000 for 12 months beginning August 1, 1980.

This award provides support for publication costs of a symposium on "Warmwater Streams" held on March 9-11, 1980, at the University of Tennessee. The objectives of the Symposium were to summarize current knowledge of the basic ecological principles of warmwater streams, to discuss warmwater stream resources, including the associated problems and opportunities, and to explore means of assuring their management. In addition the symposium examined methods for protecting the integrity of the streams, and research needs and goals and included a session devoted to threatened and endangered species of warmwater streams. The publication will be of great value to those involved in warmwater stream resource management, and will have broad application to the management of other aquatic resources for use by decision makers other than those in the fish and wildlife management community.

Biochemistry and Genetics of Conversion of the Plant Polysaccharides by Anaerobic Bacteria; *R. E. Hungate,* University of California—Davis, Department of Bacteriology, Davis, CA 95616; $110,194 for 12 months beginning October 1, 1980.

This project is designed to obtain greater understanding of the structure of plant cell walls by combining expertise inanaerobic microbiology and cellulose fermentations, analysis of polysaccharide components of plant cell walls with particular reference to hemicelluloses and the enzymes attacking them, and genetic analysis and manipulation of procaryotes. Plant cell walls are fractionated by application of specific microbial enzymes. The composition of products and residues from enzymatic action are identified both qualitatively and quantitatively by modern chromatographic techniques and other methods of plant tissue analysis. The genetics of the bacteria concerned with fiber digestion are examined with a view toward combining cellulolytic traits with fermentation traits needed to obtain improved microbial fermentations of plant waste materials.

Effects of Toxic Metabolites Derived from Ingested Petroleum on Some Hormonal Regulating Mechanisms in Seabirds; *William N. Holmes,* University of California—Santa Barbara, Marine Science Institute, Santa Barbara, CA 93106; $79,466 for 36 months beginning September 15, 1980.

Petroleum pollutants affect several physiological mechanisms, and most of the changes are dependent on a hormonal regulator. Mallard ducks are being fed on crude oil contaminated food to determine the specifics of the alterations induced. Changes in the hepatic mixed function oxidase enzymes are being studied in association with possible changes in the metabolism of adrenal steroids. Related aspects include experiments to answer these questions: is the impaired reproduction due to interference with normal patterns of estrogen, progesterone, and gonadotropin secretion? Can the abnormal ovarian hormone secretion patterns be reversed when the birds are fed pristine food again? Can the reproduction dysfunction be corrected by hormone replacement therapy?

The methods in use involve collecting blood samples and measuring hormone levels, after injecting trace doses of radioactively labelled corticosterone. Radioimmune assay techniques are also being used. These studies on ducks may be important indicators of impending effects of petroleum pollution in more resistant species, including man. Also, the toxic and pathological effects of these pollutants may have broad ecological implications.

Symposium on Animal and Plant Cell Culture and Their Applications; August 24-29, 1980; San Francisco, California; *Leonard Keay,* Washington University, Center for Basic Cancer Research, St. Louis, MO 63130; $4,000 for 6 months beginning June 1, 1980.

This award will support the travel expenses for speakers at a symposium on "Animal & Plant Cell Culture and Their Applications." The Symposium was organized as part of the Division of Microbial and Biochemical Technology, American Chemical Society, for their 180th Annual Meeting held as part of the Second Chemical Congress of the North American Continent in San Francisco, August 24-29, 1980. The speakers summarized the current status of their field, presented the latest significant results and pointed out problem areas which need attention as well as suggesting areas for future applications. The symposium will be published either through the A.C.S. Symposia Series or as a special issue of "Biotechnology & Bioengineering."

Emergency Request for Funds to Stay the Effects of Mount St. Helens' Ash on Plant and Crop Growth; *Robert A. Kennedy,* Washington State University, Department of Horticulture & Land Architecture, Pullman, WA 99163; $7,510 for 12 months beginning June 14, 1980.

This project is concerned with monitoring of the effects of the ash fallout from the Mount St. Helens volcano on physiological processes in plants in the Pullman, Washington area. Emphasis is being given to analysis of photosynthesis and respiration in apple trees, an important economic crop of the area. Both field grown and growth chamber-grown plants are being used. The effects of an elevated respiration rate of apple leaves exposed to the volcanic ash, especially the fluoride component, and the medium and long-term effects of volcanic ash are being measured. The toxic effects of the ash on other crops, such as potatoes is also under investigation.

Nutritional Diagnosis of Mt. St. Helens Ash Laden Forage; *Richard M. Koes*, Washington State University, Department of Animal Sciences, Pullman, WA 99163; $9,957 for 6 months beginning July 1, 1980.

Sufficient quantities of growing and cut forage, undisturbed and with various attempts at ash removal (irrigating, raking, harrowing), will be collected from areas with different amounts of ash fallout and at various distances from the eruption site to determine the effect of ash contamination on acceptability, nutrient composition, digestibility and utilization and animal health and productivity.

Support for 11th Meeting of the International Research Group on Wood Preservation at Raleigh, N.C.; *Michael P. Levi*, North Carolina State University at Raleigh, School of Forest Resources, Raleigh, NC 27607; $3,000 for 6 months beginning March 1, 1980.

The International Research Group on Wood Preservation (IRGWP) was formed in 1969 to bring together University, Government, and Industrial research scientists working in the multidisciplinary area of wood preservation and deterioration. The group has held annual meetings in various European countries. In 1980 it will hold its first meetings in the United States at Raleigh, North Carolina. The meeting will take place the week following the Annual Meeting of the American Wood Preservers Assocation (AWPA) in Nashville, Tennessee. This award provides $3,000 travel support to transport scientists from Nashville to Raleigh. It is felt that such support will encourage overseas visitors to attend both the AWPA and IRGWP meetings. This will benefit the visiting scientists, but more importantly, will allow for an interchange of ideas with a broader spectrum on scientists working in the wood preservation area in the United States. The AWPA attracts a large number of scientists interested in development and marketing who will not attend the IRGWP meeting. By encouraging overseas scientists to attend the AWPA meeting, American scientists involved in development and marketing will be exposed to current research trends and problems in other parts of the world.

The Effect of Vesicular-Arbuscular Mycorrhizae on Salt Tolerance of Tomato; *John A. Menge*, University of California—Riverside, Department of Pant Pathology, Riverside, CA 92521; $80,000 for 36 months beginning March 15, 1980.

Recent research results indicate that symbiotic vesicular-arbuscular (VA) mycorrihizal fungi can increase salt tolerance of citrus, pepper, and other plants. This project is designed to examine the extent of this mycorrhizae-induced salt tolerance in a sand culture hydroponic system. The osmotic effects as well as specific ion effects of several concentrations of Ca, Na, CL, and SO_4 are being compared on mycorrhizal and nonmycorrhizal tomato. Many mycorrhizai fungi, some from extremely saline natural environments, are being screened to determine the variation in the ability of mycorrhizal fungi to improve salt tolerance in tomato. A field study is being conducted which will evaluate the effects of VA mycorrizae upon salt tolerance and yield of tomatoes in the field. The mechanism of the mycorrhizal-induced salt tolerance is under investigation by studying its relationship to selected well-known plant repsonses to mycorrhizal infection, such as: 1) increased water uptake; 2) increased phosphorous uptake; 3) decreased root membrane permeability; and 4) cytokinin production. Results from the proposal will clarify the interaction between salt damage to plants and VA mycorrhizae and could lead to the development of greater salt tolerance in crop plants and therefore greater agricultural yield on salt-affected soils.

Patterns of Larval Dispersal of the Crustacean Panulirus Argus; *Robert A. Menzies*, Nova University, Department of Ocean Sciences, Dania, FL: $180,000 for 36 months beginning August 1, 1980.

This study is using biochemical genetic techniques to learn about the genetic structure and relationships of various populations of spiny lobsters in Florida and adjacent coastal waters. Starch and polyacrylamide electrophoretic analyses of alloenzyme systems of adult and post-larval populations are being used to provide data to aid in determining if long-distance recruitment is a major transport mechanism of both biomass and genes in this species. A comparison is being made of the genetic structure of arriving post-larvae to local as well as to distant adult populations. These studies have relevance to basic research on population biology of the spiny lobster and to management of the valuable spiny lobster fishery resource.

Test of a Process for Preparing Noncarcionogenic Food Dyes; *Bernard Miller*, University of Massachusetts — Amherst Campus, Department of Chemistry, Amherst, MA 01003; $103,610 for 24 months beginning September 1, 1980.

The number and types of food dyes presently certified for use in the United States are severely limited, and recent public concern over the possible carcinogenic properties of food additives raises the possibility that presently certified dyes (particularly azo dyes) may come under suspicion in the future.

It is the purpose of this study to test the concept that dyes bonded to edible cellulose derivatives would offer promise of being non-toxic and non-carcinogenic as food colorings. Several highly carcinogenic and mutagenic aromatic amines and azo dyes will be bonded to carboxymethylcellulose. Several linking agents are being employed. The mutagenic properties of these cellulose derivatives are being tested by means of the Salmonella/mamallian- microsome mutagenicty test.

Biology and Control of Varroa Jacobsoni and Important Parasitic Mite of Honey Bees; *Roger A. Morse*, Cornell University, Department of Entomology, Ithaca, NY 14850; $44,205 for 22 months beginning March 15, 1980.

The investigator is obtaining basic life history information about a parasitic mite of the honey bee to develop relevant methods for testing mite control procedures. This mite causes a serious honey bee disease. The methods being used include the monitoring of mite infestations, the determination of the rate of spread of the mites through a bee colony, and the testing of various control methods. This work is being done in Brazil, where the disease has recently spread from other parts of the world. It has not as yet reached the United States. The information generated by this study will help the U.S. Dept. of Agriculture make policy decisions regarding imports of bees and bee products, and provide information needed for the refinement of a contingency plan should the mite be found in the U.S. The American principal investigator is collaborating with a Brazilian scientist.

Development of Microbial Enzymes for the Detoxification of Pesticides; *Douglas M. Munnecke*, University of Oklahoma-Norman Campus, Department of Microbiology, Norman OK 73069; $89,000 for 24 months beginning March 14, 1980

The initial objectives of the research are to conduct a screening program for the detection of microbial enzymes which can detoxify pesticides. Secondly, these newly discovered enzymes which are capable of detoxifying dithioates, phenyl carbamates, phenoxyacetates, or organophosphate pesticides will be examined to determine if they show the required basic biochemical characteristics for potential industrial use in both point source and non-point source pesticide pollution control systems. A screening program will be conducted to isolate from environmental and culture collection microorganisms both constitutive and inducible pesticide hydrolyzing enzyme systems. These enzymes will be examined in regard to their substrate specificity for various pesticides, the kinetics of enzymatic detoxification, as well as the influence environmental parameters such as temperature, pH, salt concentration, and solvent and pesticide formulation have on enzyme activity. From these experiments, it will be possible to determine if these newly isolated microbial enzymes can be used in industrial processes. The ultimate application of this preliminary research is to help develop enzyme systems which can be used in immobilized or soluble form for the detoxification of pesticide production waste waters, spray solutions and spray tanks, excess pesticides, pesticide containers, and spills of pesticides in soil or other media.

Applications of Ecological Population Dynamics to the Pesticide Resistance Problem to Reduce Environmental Risks; *David Pimentel*, Cornell University, Department of Entomology, Ithaca, NY 14850; $124,980 for 36 months beginning March 1, 1980.

This research is investigating the ways in which population dynamics can be applied to reduce the environmental risks of pesticide resistance developing in insect pests. Several strategies are being tested for manipulating ecological systems to prevent the development of resistance in target pest populations. These include: 1) manipulating the number and intensity of control factors affecting pest population dynamics; 2) altering gene flow patterns of susceptible genes from unexposed populations into the target population; and 3) manipulating the combinations of ecological and other control factors affecting target populations. Any one or a combination of these strategies has the potential of reducing the environmental risks of pesticide resistance evolving in insect pest populations. Three population experiments are being conducted employing the housefly as the test organism. These experiments are designed to measure the reduced ability of individual housefly populations to evolve resistance when exposed to: 1) combinations of 4 different insecticides (chlordane, malathion, pyrethroid, carbaryl) at one time; 2) various gene flow rates from an unexposed population into the insecticide exposed population; and 3) combinations of ecological and insecticidal controls at one time. Based on the information obtained from these experimental population systems, some simple mathematical population models are being developed to gain a better insight into the ecological and genetical mechanism involved in these pesticide/pest population interaction systems.

Toxins from Cyanobacteria; *John H. Sasner, Jr.*, University of New Hampshire, Department of Zoology, Durham, NH 03824; $161,618 for 38 months beginning August 1, 1980.

The primary objectives are: to study the chemical properties, structure and stability of toxins from two species of fresh-water blue-green algae; to utilize fluorometric techniques for the qualitative and quantitative assay of the toxins; to analyze the physiological effects of the toxins in neuromuscular systems, including cardiac, in various mammalian, amphibian and crustacean species; and to determine the storage of the toxins by freshwater bivalves and the sensitivity of other aquatic organisms to the toxins. These studies are relevant to basic and applied research, especially in understanding water fouling and animal kills associated with blooms of these algae. Water quality for human consumption and recreational purposes may be affected by the algae toxins.

The methods to be used include lab and field studies involving: cultivation of unialgal cultures; the use of high pressure liquid chromatography for algal toxin purification; toxin bioassay using mice amphibian and lobster nerve-muscle preparations; fluorometric assay methods, and toxicity monitoring in freshwater clams in local lakes and laboratory feeding studies.

A New Approach to the Detection and Enumeration of Coliforms in Drinking Water and Raw Water Supplies; *Ramon J. Seidler,* Oregon State University, Department of Microbiology, Corvallis, OR 97331; $115,721 for 24 months beginning August 1, 1980.

This study will develop and optimize a new concept for the detection and enumeration of total coliform indicator bacteria using both the membrane filtration and fermentation tube principles. The primary efforts will be directed at sampling raw water and potable drinking water supplies. Initial efforts will be devoted to optimizing the detection principles using pure coliform cultures (stressed and unstressed) grown under laboratory conditions. The second phase will be devoted to trials in which the accuracy, specificity, reliability, selectivity, and comparability with existing standard methods will be compared.

Studies on the Mechanism of Heat Resistance of Bacterial Spores; *Ralph A. Slepecky,* Syracuse University, Department of Biology, Syracuse, NY 13210; $96,756 for 36 months beginning March 15, 1980.

Microorganisms such as bacteria which do not have a nuclear membrane exhibit wide diversity in form, structure, and physiology as a result of the many evolutionary paths they have taken since Pre-Cambrian times, when it is believed that they first appeared. Many form non-dividing resting stages having little or no metabolism, which allow them to remain dormant for long periods of time. Associated with this domancy is resistance to various environmental stresses normally lethal to the progenitor vegetative cells and other bacteria which do not form resting stages. This resistance and dormance is important in current procedures of bacterial spore control in eradicating the spores from foods and pharmaceutical products and in the preservation of these materials. Despite extensive studies the mechanisms of heat resistance and dormancy are unknown. Some current theories invoke the low water content of spores and the electronegativity of the cortex peptidoglycan in the achievement and maintenance of heat resistance while others stress various kinds of stabilization of core components. This proposal outlines experiments primarily involving stabilization of DNA based on previous results indicating that either perturbation of the spore DNA or conditions leading to changes in DNA content or association with manganese lead to alteration of heat resistance.

Reproduction and Growth in Polyploid Fish and Oysters; *John G. Stanley,* University of Maine — Orono, Department of Zoology, Orono, ME 04473; $119,892 for 24 months beginning September 1, 1980.

This is a study on oysters and salmon, treated, in the early stages of development, with cytochalasin B, to produce polyploid animals, instead of normal diploid organisms. Polyploid animals offer a potential advantage for aquaculture in that there is the possibility that they may grow faster and reach a larger size. It is the objective of this study to determine if these advantages apply to polyploid oysters and salmon. Another objective is to determine if these polyploid animals are sterile. If this is found to be the case this could also be an advantage for aquaculture purposes.

The growth of the polyploid oysters and salmon is being monitored and compared with that of untreated animals, under both laboratory and field conditions. Also, the extent of the ploidy is being determined by measuring the cell nuclear size, and by analyzing the RNA to DNA ratios using a cytochemical method.

Assessment of the Infectivity of a Pesticidal Virus in Non-target Hosts; *Loy E. Volkman,* University of California — Berkeley, Department of Entomology, Berkeley, CA 94720; $86,279 for 24 months beginning April 15, 1980.

The virus *Autographa californica* is an agent being considered for use as a commercial pesticide. While the use of viruses as pesticides seems to be a promising solution to an urgent problem, it is not without hazard. The specificity and selectivity of the viral agent must be determined. This study will examine the capability of *Autographa californica* to infect and carry on biological activity in non-target host cells such as those of man and useful insects. Particular emphasis will be placed on lung and respiratory tissues because of the aerial method of pesticide application. Both normal and disease compromised human cells will be considered. The information obtained in this study should have application to other members of the class of viruses.

Ashfall Effects on Nutrient Cycling in Moses Lake, Washington; *Eugene B. Welch,* University of Washington, Department of Civil Engineering, Seattle, WA 98195; $7,419 for 12 months beginning July 1, 1980.

The effect of the 5-10cm. ash layer in Moses Lake, Washington, on the nutrient exchange between sediment and water is being determined by comparing phosphorus and nitrogen mass balances during past years with that during 1980-81, following the Mount Saint Helens' eruption. Migration of nutrients and other elements vertically into the ash layer is being determined in cores by comparing concentrations of constituents in the layer shortly after the ashfall with those measured six months later. Laboratory studies on nutrient release with and without the ash layer removed are being performed to correborate results from the mass balance evaluation.

Optimal Management of Chum Salmon Based on Estuarine and Nearshore Carrying Capacity for Outmigrating Juveniles in Hood Canal; *Robert C. Wissmar,* University of Washington, Fisheries Research Institute, Seattle, WA 98195; $14,480 for 12 months beginning October 1, 1980.

The primary objectives will be to achieve a quantitative understanding of the manner of and constraints upon zooplankton prey utilization by juvenile chum salmon migrating from the hatchery out through estuarine and nearshore habitats. Prediction will be made of the adverse effect of prey resource depression on chum salmon growth and residence time in these habitats. Efforts will be made to minimize the adverse effects by various hatchery production, rearing and release policies. These studies are relevant to basic and applied research, especially in the fields of fish ecology and fishery management.

The methods to be used involve study of the feeding behavior of the salmon and the salmon-zooplankton interactions using video-tape recordings made in lab aquaria and in microcosm field studies. The effects of prey size and species, and light intensity and water turbidity on the salmon behavior and growth will be analyzed. Salmon stomach content analyses and otolith study will be done to aid in understanding food habits and residence times in the various habitats.

A Study of Feeding Relationships in Tuna and Porpoise Through the Application of Cephalopod Beak Analysis, *John Wormuth,* Texas A&M University, Department of Oceanography, College Station, TX 77843; $15,802 for 24 months beginning April 1, 1980.

In this study a key for identification of the beaks of 17 species of Eastern Tropical Pacific (ETP) squid are being constructed. The objectives of the study include the development of an easy method for distinguishing the different species, as well as to gain an understanding of the feeding relationships of some of the various squid predators. The predators of special interest are two species of porpoise (*Stenella longirostris,* and *S. attenuata*) and one species of tuna (*Thunnus albacares*). The squid beaks collected from the stomachs of the predators and samples from museum collections are being analyzed. These studies are relevant to the problems associated with the cooccurrence in the ETP of tuna and porpoises in feeding groups, and the need for additional data on these relationships.

The methods being used include: measurement of upper and lower parts of the squid beaks, formulation of beak size ratios, and from these, the estimation of body weights and mantle lengths. This data will generate a squid species key for identification purposes. Information on the number of each squid species present in the stomachs of the different predators will be useful in quantifying the relationship of the squid resource to the food web.

Synthesis of Novel Genes Coding for Lysine- and Tryptophan-Rich Proteins; *Ray Wu,* Cornell University — New York State College of Agricultural and Life Sciences, Department of Biochemistry, Ithaca, NY 14850; $100,000 for 24 months beginning March 15, 1980.

The objective of this project is to synthesize novel DNA molecules (synthetic genes) that code for proteins containing high percentages of lysine, tryptophan, methionine, or other valuable, essential amino acids. Enzymatic and chemical methods will be used to synthesize several families of DNA molecules followed by molecular cloning of these genes into the bacterium *Escherichia coli.* By linking these genes to a strong genetic promoter for the synthesis of large amounts of protein, the *E. coli* bacterial cells are expected to synthesize up to 40% of their proteins as the novel protein contain high percentages of lysine or tryptophan. Other families of genes will also be synthesized to produce the desired essential and scarce amino acids.

The long term goal will be to use these techniques for the improvement of the protein quality of crops.

GEOPHYSICAL AND ENVIRONMENTAL APPLICATIONS PROGRAM ELEMENT

This program element supports research which increases the rate of technical innovation growing out of discoveries in the geophysical and environmental sciences.

Artificial Aggregating Systems for Tuna Purse Seining; *Frank T. Awbrey*, San Diego State University, Department of Biology, San Diego, CA 92182; $123,216 for 12 months beginning May 15, 1980.

This project studies the sensory, behavioral, and oceanographic aspects of tuna associations with flotsam and dolphins. The objective is to utilize the results of this project as criteria for the design and development of devices (tuna aggregators) which attract tuna to them and thereby reduce the fishing on tuna associated with porpoise. The project is concentrating on: a) the acoustic detection of tuna and b) the relationships between aggregation behavior and diel movement of tuna and the physical properties of the watermass.

The first part of the project is evaluating the feasibility of using passive acoustical listening devices for detecting and locating schools of tuna. Two systems are being evaluated simultaneously, a linear hydrophone array and a sonobuoy patterned after those used by the U. S. Navy.

The second part of the project uses sonic tags to mark and follow yellowfin tuna to provide a record of their movements in three dimensions. Light and the variation in water temperature and oxygen with depth are measured aboard ship and related to the activities of the fish.

This work is a follow on to studies of tuna and porpoise behavior during purse seining operations which was funded under NSF Grant No. AER 76-19984.

Effects of Weathering on Geotechnical Properties of Mt. St. Helens Ash — Baseline Study; *J.R. Bell*, Oregon State University, Department of Engineering, Corvallis, OR 97331; $10,519 for 12 months beginning August 1, 1980.

The project is to locate and preserve test sites covered by fresh Mt. St. Helens ash deposits suitable for long term studies of the effects of weathering on geotechnical properties and to establish baseline engineering characterization data including strength and consolidation test data. The Mt. St. Helens eruption provides a unique opportunity to study the formation of the unusual clay minerals derived from the weathering of volcanic ash in humid climates from the initial state and to document the effects on geotechnical properties. This study is 1) establishing protection for suitable sites for long term studies; 2) collecting appropriate representative and undisturbed samples; 3) performing index, strength, moisture-density, and consolidation tests to establish baseline data, and 4) producing a report containing the study results and recommendations for future tests.

Optimization of a Sensor for Ore Beneficiation Processes; *James C. Conti*, Bioresearch Inc., Farmingdale, NY 11735; $92,971 for 18 months beginning March 1, 1980.

This is a renewal of an earlier project (DAR 77-24213) directed towards the development of a surface charge potential sensor to improve the technology and economics of wet processing of minerals. The objectives of the follow-on effort are (a) extension of surface charge monitoring to a variety of ore constituents, (b) increased electrode stability, (c) temperature compensation, (d) improved instrumentation and (e) development of a simplified, more compact sensor flow loop system to minimize weight and volume of the total sensor package.

Microbial Polymers and the Accumulation of Metals in Aquatic Environments; *William C. Ghiorse*, Cornell University, Department of Microbiology, Ithaca, NY 14850; $133,439 for 36 months beginning March 15, 1980.

This study will have three major objectives: (1) study of the abundance of polymer-producing, metal-depositing microbes in samples taken from various aquatic environments by direct analytical microscopy; (2) isolation of metal-depositing, polymer-producing microorganisms from the environments and study of their mechanisms of metal accumulation using various techniques for examining the physiology and biochemistry of metal deposition, especially the deposition of manganese; and (3) assessment of the contributions of polymer-producing microorganisms to the accumulation of metals in natural environments and in environments altered by man using direct methods of observation. Experiments will include assessment of the feasibility of using microorganisms and their polymers for biologically controlled, metal-scavenging processes. This research can be expected to contribute valuable information concerning the effects of microorganisms and their polymers on the uptake, retention and redistribution of metals in aquatic environments, including sediments containing ferromanganese concretions. In addition, it should reveal natural mechanisms of metal accumulation which can be applied to the development of biological processes for scavenging metals, thus conserving energy and protecting the environment.

Separation of Metals by Electrochemical Reduction in Molten Silicate Rocks and Slags; *Larry A. Haskin,* Washington University, Department of Earth & Planetary Sciences, St. Louis, MO 63130; $159,215 for 36 months beginning March 15, 1980.

The objective of this project is to explore the potential usefulness of electrochemical separation of useful metals and other industrial raw materials from molten silicate liquids. Exploratory work has shown that iron, silicon, titanium and oxygen can be separated electrochemically from molten silicate rock. This exploratory work will be extended to other metals and other silicate systems. Values will be determined for electrochemical parameters that can serve as the basis for predicting and optimizing conditions of separation in untested silicate systems. Tests will be done on slags rich in uncommon but valuable elements (e.g., tantalum) and slags from iron processing and on fly ash. Once the chemistry is well understood, analyses will be done of energy and cost requirements and other aspects of scaling the process up to a useful productive level.

Evaluation of Secondary Gas Haloes as a Method of Deep Exploration; *Stephen E. Kesler,* University of Michigan, Department of Geological Sciences, Ann Arbor, MI 48109; $59,789 for 18 months beginning August 1, 1980.

The objective of this project is to determine the feasibility of utilizing secondary gas haloes as a method of exploration for buried sulfide ore bodies. The project includes three tasks: (1) a laboratory investigation of the gases generated by decomposing metal sulfide minerals; (2) a laboratory and field evaluation of the best methods for collecting secondary gas samples, and (3) a preliminary field comparison of gases generated by sulfide minerals and organic material in natural environments.

The first task will be to determine the speciation and relative abundances of gases given off by decomposing metal sulfide minerals. Both aqueous and gaseous species in the system will be measured. The second task will compare the efficacy and convenience of the three main methods of gas collection (suction pump, passive field collector and evacuation of a soil sample). The final task includes controlled field experiments as well as the collection of gas samples over a known ore body.

A comparison of Gas Techniques Useful in Geochemical Exploration and Analysis of Time Variation in Gas Emission; Ronald W. Klusman, Colorado School of Mines, Department of Geochemistry, Golden, CO 80401; $23,575 for 15 months beginning August 1, 1980.

A number of time dependent meteorological and secondary variables influence gaseous emission from the earth's crust. The objective is to determine the crustal emission of several gases useful in geochemical and geothermal exploration and potentially useful in earthquake prediction, simultaneously, in a "continuous" mode over a period of one year. The similarities and differences in the behavior of Hg, Rn, and He in a closely monitored natural experiment are being determined.

The emission of these gases is being related to the following meteorological and secondary variables outside temperature, outside relative humidity, ouside barometric pressure, instrument vault temperature, vault relative humidity, vault barometric pressure, water table, soil moisture, soil temperature, precipitation events, wind, soil freeze-thaw, and solid earth tide. The mercury emission is integrated over 2½ hour intervals. Radon is measured by two techniques in duplicate: weekly using Track Etch cups and daily, using small electronic detectors. Helium is measured in duplicate on a daily basis using a small mass spectrometer system.

The different gas techniques are being compared to each other using correlation analysis and each with meteorological and secondary influences using stepwise regression analysis. During data analysis, methods will be proposed for the application of the results to a practical geochemical or geothermal exploration program.

Application of Rock Physics to Borehole Studies; *Amos M. Nur,* Stanford University, Department of Geophysics, Stanford, CA 94305; $93,180 for 18 months beginning October 1, 1979.

The objective of the project is to simulate, in the laboratory, the in-place conditions within a borehole of several kilometers depth in the earth's crust and then measure various rock properties. The independently controlled parameters which will be utilized to simulate in-place conditions are: confining pressure, stress, fluid pore pressure, and temperature. The laboratory system will be used to study the following problems for three rock types: (1) seismic wave velocities and attenuation in a borehole configuration as a function of overburden and pore pressures as well as temperature; and (2) development of the basic characteristics for a means of determining the permeability of the rock from an instrument lowered down a borehole.

Rock types to be analyzed are fractured granite, porous sandstone, and shale.

This project will demonstrate the feasibility of this approach and obtain preliminary data for the aforementioned rock types. Once the system is validated, a basis will be provided for more extensive tests and utilization of the concept for a new borehole technique to be used in exploration. The technique is particularly applicable in exploration for energy and geothermal resources as well as for determining the potential for in-place gasification and liquification of oil shales and tar sands.

The Role of Trace Elements and Additives in Non-Ferrous Electrolytic Processing; *Thomas J. O'Keefe,* University of Missouri Rolla, Materials Research Center, Rolla, MO 65401; $11,992 for 12 months beginning September 1, 1980.

The control of the cathode deposition process is the essential step in the electrolytic production of non-ferrous metals. Previously, industrial conditions were such that prior art and experience were usually deemed sufficient to yield a suitable product, but the situation has altered dramatically in recent years. Energy and mineral costs and availability plus the stringent requirements of environmental regulations have forced a re-evaluation of previous technical policies. The recognition of the need for a better grasp of the process basics is now readily acknowledged. The incentives for further improvements are obvious, and appropriate programs must be developed if our country is to maintain its position in nonferrous metal production. The project is directed towards delineating the influence of certain trace metal impurities and additives on metal electrolysis. The research will be conducted by a team of technical personnel from the university community and four industrial metal producers. The short term goal will be the development of dynamic electrochemical techniques for the rapid evaluation of electrolyte quality. Ultimately, the basic mechanisms involved in causing the observed electrochemical behavior will be studied. Electrode characterization (Auger spectroscopy, SEM, and x-ray analyses) will be performed in conjunction with the polarization studies.

This is a continuing grant for 36 months.

COHERENT AREAS

This section describes the current "coherent areas" of the Division of Applied Research. These areas have emerged as clusters of multidisciplinary research projects which are directed toward studying similar or related applied problems. The areas are flexible; old ones will be phased out and new ones created depending on developments in the fields of applied science in which they are grounded.

GROWTH, INCOME AND EMPLOYMENT

NSF Program Emphases

Research in this area seeks to improve our understanding of policy issues such as unemployment, inflation, and capital shortages, as well as to improve our understanding of the policy instruments available to decision-makers to influence these problems. Program emphases include: the use of micro data to examine public policy decisions which influence aggregate activities such as migration, inflation, unemployment and tax reform; support of research dealing with the price adjustment of real assets to reflect inflation and issues such as the welfare gains to firms of such adjustments; empirical analysis of U.S. financial behavior, flow of funds hypothesis, and determination of interest rates; and empirical analysis of the effects of the governmental structure of taxation, expenditure, the control of externalities and agenda setting. An interesting example of research in this area is the simulation of macroeconomic activity through individual units. A micro simulation study of the distribution of tax burdens and income within the household sector of the economy identified which households would benefit and which would lose under alternative tax policies. This information provides part of the analytic base for tax reform deliberations being conducted by the executive and legislative branches of government.

Special Concerns

An opportunity exists for research which examines the impact of change on economic performance. Examples could be the impact of exogenous energy prices on the U.S. economic performance or the impact of climate changes on U.S. economic performance. The examination of the effects of these forces on the economy provides an interaction of both social and physical science disciplines. More empirical research is needed into the engineering/econometric approach to measure capital-factor input complementarity and substitution.

Racial Wages and Employment in South Carolina Industrial Labor Markets: 1910-1978; *James J. Heckman,* National Opinion Research Center, Chicago, IL 60601; $163,139 for 18 months beginning April 1, 1980.

The recent economic history of South Carolina is representative of that of many Deep South states. Combining U.S. government statistics with statistics from state agencies, it is possible to develop a unique data set on racial employment and wage rates that spans the period 1910-1978. With this data set, it is possible to assess the quantitative importance of the following three explanations of black economic progress in the state: (1) improvements in the quality and quantity of black schooling have increased black economic status; (2) affirmative action programs have stimulated black economic progress, and (3) "tight" labor markets and industrialization have significantly upgraded the status of black workers by making black labor a scarce factor in the South Carolina labor market. Given the length of the time series, it is possible to place recent developments into historical context.

Dynamic models of factor demand for race groups will be developed as will models of labor supply for specific industrial sectors. In particular, the research will examine the impact of minimum wage laws on employment and wage rates of specific race-sex groups.

Carnegie-Rochester Conference on Public Policy; *Allan H. Meltzer,* Carnegie-Mellon University, Department of Economics & Social Science, Pittsburgh, PA 15213; $100,015 for 24 months beginning September 1, 1980.

The Carnegie-Rochester Conferences are scientific conferences on economic analysis applied to issues of public policy. Conferences are held semi-annually. Participants come from academic institutions, policymaking agencies and the press. Papers and discussion are directed to topics of current and long-term interest. The purpose of this project is to hold four conferences during the 1980-1982 period.

Conference papers are published in a supplement to the *Journal of Monetary Economics* within 9 months of the conference. This permits a wider audience to have access to the papers and discussion without long delays.

REGULATION RESEARCH

NSF Program Emphases

The program in Regulation Research seeks to improve understanding of costs, benefits, and equity consequences of the United States regulatory regime and to develop information useful for improving regulatory processes so they may more efficently and accurately accomplish social goals. Areas of concern include political and managerial decision making in the regulatory process, behavioral consequences of regulation, income and wealth redistribution, legislation, economic efficiency, and social and psychological implications of the U.S. regulatory regime. In specific projects, the emphases are applied either to general policy issues or to specific industries, firms, sets of regulations, regulatory agencies, or samples of affected parties such as interest groups, households, consumers, or other relevant groupings. The disciplines of economics, law, political science, sociology, public administration, organizational and individual psychology, and others are brought to bear on these issues. Results from a study of occupational licensing laws, for example, challenged the widely held belief that the minimum entry qualifications set by such laws serve to raise the quality of service provided by the regulated occupations and insure that the consumer receives better service for his money.

Special Concerns

An increasing emphasis is emerging in four aspects of regulation research: the impact of a large number of diverse regulations on decision making of the firm; the impacts of regulation on technological progress; effects of transitions from an established regulatory regime to a preferred alternative; and research on compliance and enforcement of regulations.

Regulatory and Distributional Consequences of Alternative Electricity Rates; *Jan P. Acton,* Rand Corporation, Santa Monica, CA 90401; $128,765 for 24 months beginning August 15, 1980.

The project develops methodology for designing time-of-use (TOU) electricity rates and for analyzing benefits, costs, and distributional effects of new rates for residential customers. Analytical methods incorporate the interactive effects of demand changes on supply costs by time of day and the feedback effects on optimal prices. Demand analysis of consumer response to TOU prices emphasizes econometric models that are suitable for forecasting changes in other electricity service territories. The primary data base is the complete file of electricity consumption by time of day over a 3 year period for 2000 customers billed under experimental TOU rates in Los Angeles, combined with three extensive household surveys measuring economic, demographic, attitudinal, and appliance variables. The project assesses the transferability of Los Angeles findings to other U.S. areas using data from related but less extensive rate experiments. Major findings — to be presented in conferences, briefings, and in book form — are addressed to an audience of regulatory commissions and electric utilities who must, under recent energy legislation, conduct hearings on cost-effectiveness of such new rate structures.

Limited Entry and the American Fisherman: A Case Study of the Bristol Bay, Alaska Salmon Fishery; *Frederick G. Bailey*, University of California-San Diego, Department of Anthropology, La Jolla, CA 92093; $83,432 for 18 months beginning April 1, 1980.

American fisheries have come under regulations of a specifically socioeconomic nature only within the last decade under the rubric of limited entry (LE) policy, by which access to an increasing number of fisheries is being closed to new entrants. The long-term impact of this major change in the structure of these fisheries has never been evaluated. This project is to study the effect of this policy upon the Bristol Bay salmon fishery, a focal point of Alaska's decision to institute LE in its salmon fisheries in 1973. Bristol Bay is fished by several of the major fishery groups encountered in American nearshore fisheries today: Native Americans, professional fishermen of Scandinavian, Italian and Portuguese ancestry, and a diverse group of newer entrants to fisheries. It is hypothesized (1) that LE does not address the underlying economic problems of Native fishing communities; (2) furthermore, that LE may seriously disrupt the social structure of traditional fishing communities by impairing the transmission of the fishery to succeeding generations; and (3) that LE may prevent the professional fisherman from exercising his most effective long-term fishing strategy by limiting his flexibility to move between fisheries. A critical examination of these issues will be based upon an initial survey of the Bristol Bay fishermen during the 1979 salmon season. This will be followed by in-depth field work in several upriver Native-American communities, and in two Pacific coast fishing communities that have served, historically, as a bases for Bristol Bay fishermen.

The Relation Between Mortgage Demand and Neighborhood Characteristics; *George J. Benston*, University of Rochester, Graduate School of Management, Rochester, NY 14627; $120,000 for 18 months beginning May 15, 1980.

This study is based on questionnaires, phone interviews with home owner/buyer/sellers/improvers in our cities, plus data from lenders on approximately 5600 buyers. The study is concerned with examining six questions related to the existence of redlining in its broad sense:

1. Is unmet demand greater in the redlined area than in the control area?
2. Do home buyers in the central city experience significantly more difficulty in obtaining mortages than suburban home buyers?
3. Do home buyers in the redlined area obtain FHA mortgages because they had no other alternatives?
4. Are home improvement loans more difficult to obtain in the redlined area than in the control areas?
5. Did owners of rental houses rent their properties because they were unable to sell due to the unavailability of mortages?
6. Are the terms of mortgages made in the redlined area more onerous than the terms on mortages made in the control areas, with and without respect to the characteristics of the properties and mortgagors?

An Assessment of the Change in Economic Efficiency Resulting from Deregulation of the U.S. Air Transport Industry; *Laurits R. Christensen*, University of Wisconsin-Madison, Department of Economics, Madison, WI 53706; $190,000 for 36 months beginning March 15, 1980.

The Airline Deregulation Act of 1978 (ADA) legislated the substitution of market forces for the regulation of pricing and entry by the Civil Aeronautics Board. The principal impetus came from economists who claimed that deregulation would result in a more efficient industry. The objective of the proposed research is to assess the validity of this claim. The analysis will employ both index number techniques and statistical cost analysis to estimate efficiency changes. Because of the non-experimental nature of the data, careful research will be required to isolate the effect of deregulation from the effects of other factors. The methodology will be to model the structure of cost in the U.S. airline industry in using the pre-ADA period and post-ADA periods, as a control. The study will include the regulated Canadian air transport industry as an additional control. Deregulation of air transport and proposed deregulation of other industries has stirred considerable controversy. Opponents claim that other goals override prospective increases in economic efficiency. The purpose of the research is to ascertain actual changes in efficiency and thereby clarify the tradeoff which exists between economic efficiency and other goals.

The Market Effects of Lawyer Advertising; *Steven R. Cox*, Arizona State University, Department of Economics, Tempe, AZ 85281; $180,000 for 28 months beginning April 1, 1980.

This research builds upon prior work on the economic impact of legal service advertising under NSF award DAR77-14156. The earlier research suggests that the potential impact of lawyer advertising will be felt in three areas of the market for routine legal services, namely output, price and firm size. It is hypothesized that the dissemination of information about the availability of and fees for routine legal services via advertising may increase the demand for these services. With increased demand, firms specializing in the delivery of those services can realize certain economies of scale through expansion. This should decrease unit production costs. As a result of these demand and cost condition changes, the equilibrium level of service output will increase and the equilibrium level of service fees will fall as long as supply more than meets demand. This project empirically tests these hypotheses by the creation and economic analysis of data in five metropolitan markets where advertising of legal services varies widely.

Helium Conservation and Public Policy; *Dennis N. Epple,* Carnegie-Mellon University, Graduate School of Industrial Administration, Pittsburgh, PA 15213; $68,442 for 18 months beginning July 1, 1980.

The objective of the proposed research is the development and application of a model to analyze alternative helium storage policies. The model will permit an analysis of the effects of changing assumptions about undiscovered reserves, future growth of demand, discount rates, extraction costs and other variables. The research will begin with development of a theoretical model of an exhaustible resource (helium) whose rate of production is determined by the rate of production of a second exhaustible resource (natural gas). Computational procedures for solving the model will be developed. Sensitivity analysis will be employed to identify policies that yield relatively favorable results under a variety of conditions. An easily accessible computer program will be developed to facilitate re-evaluation of helium storage policies as new information becomes available.

Economic and Other Factors in Youth Smoking; *Michael Grossman,* National Bureau of Economic Research, Cambridge, MA 02138; $150,780 for 24 months beginning October 15, 1980.

The objective of this project is to investigate empirically economic and other factors in youth smoking. The research emphasizes the effects of price variations due to variations in cigarette excise tax rates among states of the United States and the effects of government regulations such as the Fairness Doctrine and the ban on cigarette advertising on radio and television. Other determinants based on the characteristics of youths and their families also will be examined. The objectives are implemented by tapping two unexploited but rich data bases which taken together span the period of the last decade. These are Cycle III of the U.S. Health Examination Survey and the six U.S. National Surveys on Drug Abuse. The methods of procedure are ordinary least squares multiple regression analysis and its modifications, including logit and tobit regression techniques. The research provides empirical estimates on the potential effects of various government policies to discourage cigarette smoking by youths. Thus, it is intended to be useful to government policy makers who must allocate scare resources among competing policies to curtail this behavior.

Cartel Behavior and Exhaustible Resource Supply: A Case Study of the World Oil Market; *Henry D. Jacoby,* Massachusetts Institute of Technology, Sloan School of Management, Cambridge, MA 02139; $149,922 for 24 months beginning August 15, 1980.

The project is developing forecasting methods that integrate some of the considerations which influence investment in oil capacity and the level of oil exports: e.g. (1) the geology and microeconomics of exploration and production, and (2) macroeconomic and financial effects of oil investment and export sales. The effort is a continuation of NSF-sponsored research which has focused on these aspects. Simplified methods of disaggregated analysis of oil exploration and production are being developed, and a country-level model of oil finance has been formulated and tested. Prior research has proceeded sufficiently well that it appears possible to merge the two into a unified analysis.

This research is expected to contribute to our understanding of oil supply from critical regions of the world; it also should lead to better supply analysis for inclusion in the oil system models maintained by U.S. government agencies, university research and non-profit groups, and private industries.

Conference on Managing the Transition to Deregulation; *Wesley A. Magat,* Duke University, Graduate School of Business Administration, Durham, NC 27706; $12,000 for 6 months beginning April 1, 1980.

The Duke Center for the Study of Business Regulation plans a scholarly conference on managing the transition from regulation to competition in industries such as airlines, cable and pay television, trucking, railroads, securities and some professional occupations. Although much has been written about the long-run effects of deregulating these industries and other similar ones, little serious study has been given to the questions of how to reduce the transition costs associated with deregulation and how the character of the transition will affect the eventual industry structure and performance. Given the ongoing deregulation of the airlines and cable industries and the current interest in further deregulation proposals, May 1980 provided an opportune time to examine the policy issues associated with managing the transition to deregulation, both from conceptual and empirical approaches.

Six papers were commissioned and twelve discussants for the papers invited. A four-person round table discussion was organized on what was learned from the conference, how to utilize that knowledge, and areas in need of further theoretical and empirical study. Participants were drawn from the high quality regulatory economists, policy scientists, and lawyers interested in the problem of managing the transition to deregulation. The conference was held at Duke University for two and one-half days.

Alternative Models of Regulatory Enforcement in Housing; *H. L. Ross,* State University of New York-Buffalo, Baldy Center for Law and Social Policy, Buffalo, NY 14260; $67,581 for 12 months beginning September 15, 1980.

This research examines the regulatory enforcement process by focusing on housing inspectors in several different enforcement agencies with different enforcement models. The three cities selected for study are Buffalo, Boston, and Baltimore, which all share susceptibility to the forces of urban blight but which differ in the goals and organization of their inspection systems. Inquiry will center on the formally unrecognized pressures brought to bear on inspectors for supervisors, complainants, property owners, and other sources, and on the effect of these pressures on the process and outcome of housing inspection. The law-in-action will be systematically compared with the formal law applicable to housing in these cities. The goal of the study will be a theoretical contribution to the literature on street-level bureaucracy and dilemmas of governmental regulatory action, along with the development of suggestions for improving the inspection process as a tool for resisting the forces of urban blight.

Research methods will include observation and interviewing of samples of inspectors, supervisors, complainants, property owners, and housing court officials in the three cities, along with quantitative analysis of approximately 1,000 case files concerning alleged violations of the law.

Antitrust Economics: The Transaction Cost Approach; *Oliver E. Williamson,* University of Pennsylvania, Department of Economics, Philadelphia, PA 19104; $109,600 for 36 months beginning July 1, 1980.

The proposed research will both contribute to antitrust scholarship and make the results of recent antitrust teaching and research available to a wider audience. The undertaking is an outgrowth of antitrust enforcement, teaching, and research over the past twelve years. It will both extend this work and pull it together in a way that makes it more accessible to legal specialists.

Extensions of four kinds are contemplated, all of which rely on transaction cost reasoning. The first of these involves assessing and operationalizing what is at stake in the area of strategic behavior. The second entails an effort to evaluate fairness and its significance for antitrust enforcement. The third involves an elucidation of the concept of "bounded rationality," both as this applies to micro-economic analysis in general and antitrust economics in particular. The application of "decision process analysis" to antitrust is the fourth.

While each of the parts is important in its own right, the policy significance of the project is greatly enhanced by the plan to integrate these materials with earlier work (also of a transaction cost kind) and produce a work on antitrust economics that is accessible to lawyers as well as economists. By providing a different yet integrated and expanded treatment of what antitrust is all about, it should contribute to more informed and better public policy in the antitrust enforcement area.

Intervening in Markets on the Basis of Imperfect Information: An Information Theoretic Approach; *Louis L. Wilde,* California Institute of Technology, Department of Economics, Pasadena, CA 91104; $64,528 for 12 months beginning October 1, 1980.

This research attempts to illuminate the questions of when and how the state should intervene in markets on the basis of information imperfections. Present and proposed regulatory initiatives do not rest on a sophisticated understanding of how environments characterized by imperfect information behave. The research responds to this problem by (i) constructing a set of equilibrium search models that rest on relatively realistic assumptions about how consumers and firms behave in the face of uncertainty; (ii) using these models to derive criteria for when and how interventions on the basis of imperfect information should be made; (iii) testing these criteria against the relatively large amount of data that now exists respecting how consumers and firms actually behave; and (iv) communicating results to economists, by publishing in economics journals, and to decisionmakers, by publishing easily understandable versions of the work in law reviews. This research program should increase understanding of how environments characterized by imperfect information behave and expand the set of policy options available to actual decisionmakers.

TELECOMMUNICATIONS RESEARCH

NSF Program Emphases

This program supports research which applies the tools of the economic and social sciences to improving understanding of a broad range of issues raised by rapid innovation in the telecommunications and information industries, and by the growing importance of telecommunications to the U.S. economy and society. Projects supported fit into three broad categories: (1) proof-of-concept experiments in the advanced application of telecommunications technologies to improve service delivery, enhance productivity, and to test hypotheses about social and economic impacts of innovations; (2) empirical studies of the economic and social effects of telecommunications based activities on society, including broadcast television funds transfer systems, substitutes for travel, common carrier and specialized communications systems; (3) analytic studies of various public policy issues in communications and information policy which can improve the long term scientific understanding of the issues, ranging from analyses of changes in industry structure to studies of the policy process.

Research on the potential impacts of innovations in interactive two-way television and computer applications provides an example of work supported by this program. Three experiments were conducted in the field which analyzed the psychological factors involved in optimizing human communication mediated by a computer; sociological changes in patterns of interaction among the elderly; and econometric models of the allocation of the costs of interactive television and computer innovations, and of the viability of various applications in other settings. The experimental applications have been adopted by numerous communities in the U.S. and Europe. Demonstration programs in the Department of Health, Education and Welfare; the Department of Agriculture, and the Corporation for Public Broadcasting are modeled on the NSF studies.

Special Concerns

The rapid rate of scientific progress and technological innovation in systems combining communications and computing offer a multitude of opportunities for new information services and for improved management or organizations. Projects supported provide basic data testing benefits and costs assumptions, as well as uncovering unanticipated consequences. This knowledge is the "basic" information upon which larger scale demonstrations are based to test markets and diffuse innovations. The NSF program undertakes scientific tests exploring advanced concepts, developing concepts and methods of analysis.

Teletext for Public Telecommunications Services; *John T. Carey*, New York University, Alternate Media Center, New York, NY 10003; $200,000 for 24 months beginning April 1, 1980.

"Teletext" is an innovative broadcast telecommunications application which combines computing and television technologies to transmit textual information to residential television sets. The purpose of this project is to explore the use of this innovation for non-commercial, public service, purposes. Research conducted consists of systematic investigation of the organizational and economic feasibility of implementing teletext services on public television, laboratory experimentation on human factors associated with the perception of textual information via television, a pilot trial of the technology and service in natural settings, and the development of design for a larger scale experiment and evaluation, aimed at producing sufficient information for public policy decisions about general implementation of teletext services.

Additional support for the project is provided by the Corporation for Public Broadcasting and the National Telecommunication and Information Administration.

Ninth Annual Telecommunications Policy Research Conference; *Barry G. Cole*, University of Pennsylvania, Annenberg School of Communications, Philadelphia, PA 19104; $17,000 for 9 months beginning October 1, 1980.

This award provides partial support for a conference on telecommunications policy held in April, 1981 at Annapolis, Maryland. The conference brings together research performers from universities, industry and government agencies, and telecommunications policymakers, to discuss findings from recently completed research projects, and to identify future research needs. Topics discussed include technological and scientific advances, applications, market behavior, and economic and social impacts relating to telecommunications policy. Special emphasis is placed upon the impact of deregulation.

Pricing of Local Telephone Service — Phase II; *Bridger M. Mitchell,* Rand Corporation, Santa Monica, CA 90401; $199,527 for 24 months beginning October 1, 1980.

This project examines the distribution and allocative effects of usage sensitive pricing schemes for local telephone services, which are expected to replace flat rate pricing as technological and regulatory innovation occurs. In particular, the aim is to determine the behavioral and economic impact on various user groups such as the aged, minorities, and low income and the nature of benefits and costs to regulated telephone companies. Data for the study are from an experiment conducted by General Telephone Company of Illinois, from several telephone companies in areas where various usage sensitive pricing services are available as an option, and from public feelings. The project continues work begun under grant DAR77-16286, focusing on the costs of implementation of measurement technologies and methods.

Board on Telecommunications Computer Applications; *Roman V. Mrozinski,* National Academy of Sciences, Washington, DC 20418; $20,000 for 12 months beginning July 1, 1980.

This award is for support of the Board of Telecommunications-Computer Applications of the National Academy of Sciences. The Board is supported by several agencies for the purpose of collecting, analyzing, and dissemenating information about significant developments in the field of computer and telecommunications technology and applications. It also provides background briefings to agency sponsors, telecommunications policy makers and holds public symposia on current technological and scientific trends.

Demand for Pay Television and its Impact on Expansion of Cable Availability; *Michael D. Wirth,* University of Denver, Department of Economics, Denver, CO 80208; $46,560 for 12 months beginning April 1, 1980.

This study will provide an estimate of the demand function for perchannel pay cable television. The results of this analysis will yield information concerning: (1) the relationship between the demand for pay cable and the demand for basic cable, (2) the price elasticity of demand for pay cable, (3) the relationship between over-the-air same-market TV configurations and the demand for pay cable, (4) the relationship between basic cable service configurations and the demand for pay cable, (5) the relationship between market demographics and the demand for pay cable, (6) the effect of pay cable on cable system profits, (7) the relationship between cable system ownership and the demand for pay cable, (8) the effect of pay cable on the need for cable system distant signal carriage, and (9) the relationship between pay cable affiliation and the demand for pay cable. The demand function for pay cable service is estimated using ordinary least squares regressions. The functional forms employed are derived from using a probabilistic approach to a household's cable demand decision.

PRODUCTION RESEARCH AND TECHNOLOGY

NSF Program Emphases

The Production Research Program supports research on automation and new process technology. The research is concerned with technical problems which underly both the physical transformation of objects and the informational transformation necessary to understand, model, control, and carry out manufacturing operations.

As an applied science program, production research has both utilitarian and intellectual goals. The first intellectual goal is to establish a science base for manufacturing. The second goal is to transfer intelligence from people to machines. The utilitarian goal is to provide the knowledge needed to generate new production technologies which may yield major increases in industrial productivity. Of particular interest is the class of versatile, programmable, computer based production technologies which will be required in the future for automating the manufacturing of products made in small batches. Research supported by DAR on the optimal design and operation of computerized manufacturing systems has been applied in manufacturing. Increased output resulted from changes in computer control software systems, materials handling and scheduling rules, and machine pooling.

Special Concerns

It is significant that the Production Research and Technology Program's support of research has stimulated interest in user and supplier companies in pursuing promising avenues of research. Developments which appear to merit future attention are computer vision, robots, and computer languages.

Construction of Simple 3-Dimensional Computer Part Models Based on Visual Range and Intensity Data for Locating Industrial Parts; *Robert C. Bolles,* SRI International, Artifical Intelligence Center, Menlo Park, CA 94025; $134,990 for 24 months beginning March 15, 1980.

This research investigates a fundamental problem in industrial automation: locating parts with three-dimensional uncertainties in their position and orientation. Typical applications include locating parts stored in bins or hanging on hooks.

Past work at SRI International has concentrated on the far simpler, 2-dimensional problem of locating workpieces that lie on a flat surface. The extension to 3 dimensions will require far more sophisticated part-modeling and image-interpretation techniques. SRI's approach will be to use 3-dimensional part models to interpret range and intensity information. Range information is to be used because, unlike intensity information, it directly encodes the 3-dimensional properties of the scene; moreover, it appears practical to gather range information for a large class of industrial tasks. SRI proposes using 3-dimensional part models because they not only have the potential of greatly simplifying the process of locating a part, but can also be derived from data bases commonly available for industrial tasks.

The goals of this research are to (1) develop a scientific methodology for characterizing the a priori information about a part that can be used to locate it, (2) develop mathematical models to incorporate this information into the locational process, and (3) implement computer programs that utilize models to locate a large class of workpieces.

Computerized System for the Manufacture of Small Parts; *Nathan H. Cook,* Massachusetts Institute of Technology, Department of Mechanical Engineering, Cambridge, MA 02139; $157,000 for 24 months beginning January 1, 1980.

This award continues work supported under NSF Grant No. DAR76-80323. Computer models are being developed for the overall design, analysis and simulation of computerized manufacturing systems (CMS) consisting of a number of numerically controlled machine tools and ancillary materials, and part handling equipment. The emphasis is on systems for machining small parts of rotation. The CMS model has as input technical and cost data on machine tools, cutting tools, machinability data, and types of parts to be produced. The output is a system configuration for machining a class of parts and data on performance and cost for this configuration. The following software modules have been constructed:

PROCESS: To optimize each operation on each potential machine.

CONFIGURE: To determine a set of machines capable of machining a given part mix.

ROUTE: To establish part routes, machine schedules and tooling assignments.

SIMULATE: Discrete event simulation to assess system performance.

COST: To estimate capital, operating and part costs.

Work under this grant seeks to enhance the performance of these modules. Research will concentrate on the configure and cost modules with emphasis on possible optimability of algorithms for machine selection, and the effect of time varying part mixes which differ considerably from the original part mix.

Feedback in Robotics for Assembly and Manufacturing; *Thomas L. Defazio,* Charles S. Draper Lab Inc., Cambridge, MA 02139; $200,000 for 24 months beginning April 1, 1980.

This research is based upon previous research supported by the National Science Foundation. It is proposed to study force and position information generated at the interface where parts touch during their assembly. Assembly operations will be modeled systematically and the requirements for feedback will be determined in terms of various algorithms used in assembling objects. Such classes of assembly algorithms as force vector (accomodation) and branching type strategies based upon impacts and position data making use of correlations and inference will be examined.

The emphasis will be on a variety of approaches rather than one *a priori* favorite method. The use of feedback as an aid to assembly rather than directly implementing asembly will also be studied. This includes feedback in robot teaching, assembly progress monitoring, and quality assurance. Draper will apply background in its Remote Center Compliance technology to the above two tasks, exploring unique ideas for obtaining the necessary feedback and for performing some previously difficult operations. The results of these analyses will be tested on a small industrial assembly robot whose control system will be augmented to support experiments.

Tool Wear Sensing Via Acoustic Emission Analysis; *David Dornfeld,* University of California-Berkeley, Department of Mechanical Engineering, Berkeley, CA 94720; $87,490 for 24 months beginning November 1, 1979.

A major problem in tool wear sensing is reliability. In many instances interference from non-wear related sources such as material property variation or machine structure vibration reduces the certainty of detecting tool wear. Acoustic emission analysis is proposed as a suitable technique to monitor tool wear since the acoustic emission can be related to the deformation in chip forming and the alteration of the chip forming process due to tool wear. In addition, the frequencies of acoustic emission are far above those of tool vibration, thus interference is reduced. The root mean square (RMS) voltage level of the acoustic emission is proposed as an appropriate basis for determining the relationship between acoustic emission and the mechanics of cutting with an unworn and worn orthogonal cutting tool. Using cutting tools with modified geometries, lubrication, and various work materials, a method is proposed to determine the contribution to the acoustic emission from rubbing on the tool rake face during cutting.

Success in this research effort would encourage work to examine the potential applicability of acoustic emission monitoring to other manufacturing operations such as die wear and formability in sheet metal forming, weld metal penetration in joining, center bursting in extrusion or wire drawing, cutting tool wear in metal cutting, etc.

Micro Electrochemical Patterning of Surfaces with Applications to Fabrication of Holographic Optical Elements; *Uziel Landau,* Case Western Reserve University, Department of Chemical Engineering, Cleveland, OH 44106; $169,500 for 24 months beginning May 15, 1980.

The purpose of the proposed research is to study new micro-electrochemical plating and machining techniques for use in the fabrication of infrared holographic elements and for other precision micromachining applications.

The research proposed continues the work performed under NSF Grant DAR77-21405 "Holographic Laser Machining". A collaborative research effort exists between Case Western Reserve University and Purdue University. Case Western Reserve will concentrate on the following topics:

1. Continued experimental and theoretical study of the generation of micron scale, binary (two level) surface features using pulsed potential electroplating.
2. An experimental and theoretical study of the generation of high resolution continuously modulated surface relief using photo-assisted etching through variable density filters.
3. Quantitative, predictive modelling of localized rates of electrochemical process which hold promise for precision machining and plating applications.
4. Application of the above techniques to the generation of new types of reflective holographic elements and provision of these to Purdue University.

Automated Factory Control; *William L. Maxwell,* Cornell University, School of Operations Research & Industrial Engineering, Ithaca, NY 14850; $53,036 for 12 months beginning October 1, 1980.

Developments in manufacturing technology, operations research techniques, and computers will make possible the automation and control of individual machines and the optimization of complex systems of men and machines. Three problems must be addressed when designing and controlling the automated factory.

First, long-range market forecasting must be possible.

Second, intermediate range problems of allocating the capacity to the various product families and determining inventory stock levels for raw materials, work in progress, and finished goods must be solved. Systems must be developed that deal with the allocation of finite production capacity, the affect of lot sizing, quality control, randomness of demand, the capacity of material handling and control system, etc.

Third, day-to-day operations must be controlled. This involves assigning work to machines, the raw material inventories required for each type of product, the tooling available, maintenance policies, etc.

The purpose of the research described is to create a scientific basis for the intermediate control problem of manufacturing. This involves setting up a mathematical framework that incorporates objectives and constraints not presently handled, finding an algorithm for solving the resulting mathematical problem and evaluating the model and solutions obtained.

Stochastic Modeling of the EDM Process With a View to Off-Line Optimization; *Sudhakar M. Pandit,* Michigan Technological University, Department of Mechanical Engineering, Houghton, MI 49931; $113,986 for 24 months beginning December 1, 1979.

Electro-Discharge Machining (EDM) is extensively used for specialized intricate and complex components. To satisfy the increasing demands of sophisticated component performance, longevity and reliability, greater emphasis needs to be given to quality and productivity of EDM. This research emphasizes stochastic modeling and its relationship to the physics of EDM using the Data Dependent Systems (DDS) techniques developed by the principal investigator. The quantified aspects of surface topography and material removal rate will be analytically related with process variables such as pulse energy and machining time. These relations will be used subsequently to propose a scheme for off-line optimization of the EDM process. Residual stress distribution will be investigated to relate it quantitatively to the process characteristics through the DDS modeling approach. Statistical design and analysis of experiments will be employed to minimize experimental effort. Typical tool steels, die steels and tungsten alloys will be investigated under normal operating conditions so that the results can be used by a wide cross-section of industries. A qualitative assessments of the metallurgical alterations in the surface layer as a function of machining parameters will be made.

Infrared Holographic Optical Elements with Applications to Laser Material Processing; *Donald W. Sweeney*, Purdue University, School of Mechanical Engineering, Lafayette, IN 47907; $178,239 for 24 months beginning May 15, 1980.

This research continues the work performed under NSF Grant DAR77-20684 entitled "Holographic Laser Material Processing". A collaborative research effort exists between Purdue University and Case Western Reserve University. The primary objective of Purdue's program is the development of holographic elements suitable for use with high power CO_2 lasers which can be used for industrial applications such as cutting and welding where current industrial practice requires mechanical scanning of a focused laser beam. Such holographic elements can shape the beam into the desired pattern without a complicated mechanical scanning system and offer the potential for increased production rates and product quality.

Work completed to date by Purdue has included an extensive study of computer generated infrared holograms and holographic scanners as well as directly recorded holograms. Specific topics include:

1. Continuation of the analysis of methods for computer generation of optimized holographic infrared optical elements.
2. Investigation of high numerical aperture infrared holograms recorded at visible wavelengths with computer compensation of aberrations.
3. Experimental study of wavefront aberration and laser mode structure effects in material processing.
4. Continued collaboration with Case Western Reserve University in the development of high power, high efficiency reflective holograms using new fabrication techniques they are developing.

SMALL BUSINESS RESEARCH

The Division of Applied Research participated in a "Small Business Solicitation" issued by The Engineering and Applied Science Directorate in Fiscal Year 1980. Through this solicitation, companies within the Nation's small business community which have strong research capabilities in applied science or engineering were invited to submit proposals. Proposals were judged according to their scientific merit and the importance of the problems they addressed. The solicitation aimed to encourage innovative research and the rate of technological innovation. The solicitation targeted the following thirteen areas for research:

1. Advanced Measurement Research
2. Advanced Production Research for Discrete Parts Manufacturing
3. Industrial Processes
4. Deep Mineral Resources
5. Alternative Biological Sources of Materials
6. Microbial Fertilizers, Activators, and Conditioners
7. Human Nutrition
8. Advanced Marine Farming
9. Groundwater Pollution
10. Earthquake Engineering, Architecture, and Urban Planning
11. Science and Technology to Aid the Handicapped
12. Appropriate Technology
13. Applied Research Project Support

The Division of Applied Research supported research in categories 1, 2, 3, 4, 6, 8, 9 and 13. Other topics were supported elsewhere in the Engineering and Applied Sciences Directorate.

Awards are made in two phases and are limited in size to up to $25,000 in phase I. Phase II provides for larger awards to those companies with approaches that appear most competitive as a result of the first phase.

Detection and Identification of Fish Schools from Sonar Echoes; *Richard A. Altes,* Orincon Corporation, La Jolla, CA 92037; $24,639 for 6 months beginning September 1, 1980.

Efficiency of tuna and other commerical fishing ventures depends upon the fishermen's capability to detect and classify schools of fish at long range. Long-range sonar detection is degraded by downward bending of transmitted sound, and by the presence of noise and clutter. A general solution of the problem involves towed upward-looking sonar transducers at depths on the order of several hundred meters, and a signal design/echo representation that contains sufficient information to allow recognition of a fish school and rejection of surface reflections.

A theoretical approach to this measurement problem incorporates pattern recognition techniques as applied to spectrograms of broadband echoes, and optimum sonar placement strategies using ray-tracing arguments. The approach can be applied to existing echo data and to new data via computer processing of recorded echoes.

The objective of the research is to improve the detection and identification of fish schools using sonar echoes.

Commercial Potential of Sex Reversal on Hybrid Tilapia; *Terry M. Astro,* Terry M. and Sari K. Astro, Eleele Kauai, HI 96705; $22,486 for 6 months beginning September 1, 1980.

This study will use thermally discharged brackish water to culture gold colored hybrids of the hardy finfish, *Tilapia.* This fish is a reliable source of inexpensive food protein around the world, and the hybrids in particular show outstanding growth characteristics. Overpopulation of cultured animals, however, leads to stunted offspring, so techniques will be tried to grow sex-reversed fish by treatment with androgenic hormones. The all male cultures should show optimal growth when the environmental and hormonal conditions needed are determined. The research has relevance to the Marine Farming field.

Waste Pond Treatment with Immobilized Liquid Ion Exchanges; *Walter C. Babcock,* Bend Research Inc., Bend, OR; $25,000 for 6 months beginning September 1, 1980.

The objective of the research is to determine the feasibility of using microporous polymeric fibers containing liquid ion exchangers as a means of removing toxic metal ions from waste ponds. It is anticipated that the selectivity and high capacity for metal ions of liquid ion exchangers which are immobilized in the fibers can be utilized without the problems of phase separation and organic losses.

Existing waste ponds that pose a significant threat to groundwater purity and appear amenable to treatment by immobilized liquid ion exchangers will be identified. Polymeric fibers containing suitable immobilized liquid ion exchangers will be developed and tested on synthetic waste solutions, similar to those in actual ponds, to demonstrate the feasibility of the concept. Based upon the success of these laboratory experiments, two specific waste ponds will be selected for further study and field testing of the technique as a follow-on to the present project.

Investigation of In-Situ Gelation to Control Emissions from Abandoned Hazardous Waste Sites; *Robert Baron,* Energy & Environmental Engineering, Inc., Cambridge, MA 02139; $24,856 for 6 months beginning September 1, 1980.

The objective of the research is to determine the feasibility of in-situ polymerization and ion exchange as a reliable method of containing toxic substances in a dump site and preventing their seepage out of the containment area and into the groundwater. The study will determine the conditions under which various monomers injected into a soil matrix will polymerize to form an effective transport barrier and the effectiveness of in-situ polymerized ion exchange barriers for immobilizing toxic anions and cations extracted from leachates. Several toxic anion and cation species will be selected and made into aqueous solutions to simulate leachates found in chemical dump sites.

Improvement of the Transverse Strength of Graphite/Aluminum Composites by Hybridization with SiC Whiskers; *Douglas Bilodeau,* Artech Corporation, Falls Church, VA 22042; $24,305 for 6 months beginning September 1, 1980.

Graphite reinforced aluminum is one of the most promising composite materials being investigated today, but its usefulness till now has been limited by a very low transverse strength due to weak filament-matrix bonding. This project addresses the problem by incorporating silicon carbide whiskers to form a hybrid composite. Preliminary work has shown that silicon carbide whiskers can indeed substantially improve the transverse strength of graphite/aluminum.

The research is directed to optimize material parameters, develop fabrication techniques and generate an extensive base for mechanical data in order to win acceptance of the concept and stimulate application.

A Mycorrhizal Inoculated Containerized Plant Growing System; *Wm. Hugh Bollinger,* Native Plants Inc., Salt Lake City, UT 84115; $24,999 for 6 months beginning September 1, 1980.

Vesicular-Arbuscular (VA) fungi are beneficial microorganisms symbiotically associated with roots of most land plants including the major shrub species found in the semi-arid regions of the Western United States. VA mycorrhizae can increase both growth and survival of shrubs transplanted into disturbed soils and therefore may play an important role in the disturbed land revegetation.

For most severly disturbed soils, such as surface mine spoils, containerized planting systems are the only acceptable method for revegetation. However, even these systems are only marginally successful because VA mycorrhizal fungal populations are destroyed during topsoil removal, storage and redistribution. In such cases, containerized plants inoculated with VA mycorrhizae will be required for reestablishment of the fungal component and the development of stable mycorrhizal plant community.

It is the purpose of this award to test the feasibility of developing a large-scale containerized VA mycorrhizae — inoculated plant production system. Three important shrub species suitable for reclaiming disturbed sites in semi-arid regions will be chosen for the Phase I study. Each species will be inoculated in the greenhouse with one of two VA mycorrhizal fungi to be tested. Uninoculated containerized plants will be used as controls. VA mycorrhiza-inoculated planting stock developed in Phase I will be used for testing outplanting performance on disturbed sites in Phase III.

Numerical-Controlled Orbital Forging Processes; *Joseph Carleone,* Dyna East Corporation, Wynnewood, PA 19096; $25,000 for 6 months beginning September 1, 1980.

The project is an investigation of the feasibility of numerically controlled orbital forging in discrete parts manufacturing. Studies will be made of 1) sensitivities to controlling parameters, 2) flow processes in metals, 3) the use of a feedback mechanism for control. Operator controlled orbital forging is known in some European countries but virtually unknown in the United States.

Research on Adaptive Arc Tracking for Welding; *George E. Cook,* Merrick Corporation, Nashville, TN 37217; Nashville, TN, 37217; $25,000 or 6 months beginning September 1, 1980.

This project is directed toward automatic electric welding. The feasibility of using signals from the welding arc to guide the welder will be investigated. Electrical signals obtained from the welding arc will be correlated with joint geometry and weld path.

Supply-Oriented Regional Macroeconometric Forecasting Model; *Robert T. Crow,* Applied Forecasting & Analysis Inc., Palo Alto, CA 94301; $24,635 for 6 months beginning September 1, 1980.

This research is to construct a forecasting model of regional economic growth which is specified within the framework of a comprehensive set of regional income and product accounts. Phase I work will involve identifying appropriate data sources for the construction of the regional accounts, and also to demonstrate the feasibility of constructing the model and the income and product account for one state and one Standard Metropolitan Statistical area.

Alternative Silver Zeolite Concepts; *James R. De Haan,* Ionex Research Corp., Broomfield, CO 80020; $25,000 for 6 months beginning September 1, 1980.

The primary objective of this project is the synthesis and evaluation of a series of significantly lower cost silver exchanged zeolites which exhibit high adsorption characteristics for the removal of airborne species. Several suitable materials with desired microporosity will be converted into different types of zeolite structures. Those zeolites found to possess desirable hardness and suitable particle size, will be completely silvered and the silvered products will be tested for methyliodide absorption efficiency. Performance and test data using radioactive iodine 131 will be obtained.

Interpolation of N-Dimensional Geophysical Data; *James A. Downing,* Zycor Inc., Austin, TX 78741; $22,566 for 6 months beginning September 1, 1980.

The project is to devise a mathematical technique to interpolate irregularly spaced data in three or more dimensions. The objective of Phase I is to develop the theory needed to accurately interpolate N-dimensional geological or geophysical data to the nodes of a regularly spaced N-dimensional grid. The resulting algorithms will allow geophysical field data, which has been obtained at irregular sampling intervals or over irregular tracts to be properly interpolated in three or more dimensions for accurate plotting on a uniform two or more dimensional grid.

The project will begin by generalizing an existing two dimensional scheme to three and more dimensions in order to determine similarities between two, three and N dimensional interpolation problems. Several multidimensional interpolation techniques may be developed to suit different kinds of geologic data.

Electrorefining of Sodium Using Solid State Rapid Ion Conductors; *Ronald S. Gordon,* Ceramatec Inc., Salt Lake City, UT 84115; $24,494 for 6 months beginning September 1, 1980.

A research and development program is funded to investigate the production of sodium metal of extremely high purity by electrorefining commercial grades of sodium and by electrowinning sodium from salts or salt mixtures in electrolytic cells. These electrolytic cells will utilize a solid state, rapid sodium ion conductor such as sodium β''-alumina or Nasicon as electrolytes. The objectives of the proposed research and development are:

(1) The design, fabrication, and operation of cells for electrorefining high purity sodium from lower purity grades. This research will provide information about (1) attainable sodium purity levels, (2) effective ceramic lifetime, (3) cell operating temperatures, and (4) useful current densities which are necessary for evaluating the feasibility of an expanded electrowinning process to be researched in Phase II.

(2) The selection of several sodium salts and salt mixtures which could be used in the electrowinning process with the three or four most viable systems (from technical and economic veiwpoints) being chosen for in-cell evaluation during Phase II.

Thin Steel Sheet Made from Melt Extracted Flake; *Lloyd E. Hackman,* Ribbon Technology Corp., Canal Wincheste, OH 43110; $24,422 for 6 months beginning September 1, 1980.

The phase one of this research is to investigate parametric requirements for flake or particulate material made by melt extraction for use in flake metallurgic applications. The program will investigate the quality of flake particulate material as made in various atmospheres to determine the degree of atmospheric control necessary to provide a high quality product. The second investigation will be into the configuration of the particulate matter ranging from short fibrous type of material from the melt extraction process to a flake type material. The various materials produced will be inspected for surface conditions which may present potential problems in the production of metallurgical components from the particulate. An investigation will also be made into shape of the particulate as it effects bulk density prior to press forming of the material. The final step in the first phase would be the press forming of actual small coupons which can be evaluated from metallic strength properties.

Theoretical Modeling of an Innovative Unidirectional Surface Acoustic Wave Transducer; *Clinton S. Hartmann,* R. F. Monolithics Inc., Dallas TX 75248; $24,030 for 6 months beginning September 1, 1980.

An important national resource, the radio frequency spectrum from 30-1000 MHz, is underutilized due to limited selectivity of current radio frequency receivers. However, there is a demand for more radio communications channels in this frequency range which is currently not being satisfied because of potential interference to existing services. A low cost, efficient, highly selective bandpass filter technology is needed to improve spectrum utilization. The objective of this research is to conduct a theoretical modeling analysis of an unidirectional surface acoustic Wave Transducer in order to assess its feasibility as a selective bandpass filter.

Near Surface Flaw Detection by Ultrasonic Critical Angle Imaging; *B. P. Hildebrand,* Spectron Develop. Labs Inc., Costa Mesa, CA 92626; $24,723 for 6 months beginning September 1, 1980.

Modern ceramic and super alloy materials are designed for critical components where high temperatures and stresses occur. It is important that these materials be defect free so that their full potential can be utilized. This is particularly important near the surface of the component since this is where cracks are most likely to form. Conventional ultrasonic inspection techniques are least sensitive near the surface because of transducer ringdown and multiple reflections.

There is an interesting property of ultrasound which promises to provide a sensitive indicator of near surface condition, namely, the Rayleigh critical angle. The behavior of the reflected sound at the critical angle is influenced by material parameters such as grain size, hardness, surface residual stress, and material variation.

The objective of this research is to establish the feasibility of using some or all of the measurable quantities of amplitude and phase of the reflected wave, frequency of least reflection, and the critical angle itself to form images of near surface defects. By using a combination of these measures, it may be possible to separately determine grainsize, surface stress, and material defects in the near surface region of the material.

Successful completion of this research could lead to improved instrumentation for the inspection of exotic materials, and thus prevent costly breakdown of critical components due to undetected defects.

Advanced Underwater Telemetry and Voice Links for Inland and Coastal Waters Research; *Edwin Hoffman,* Osborne-Hoffman Inc., Pt. Pleasant Bea, NJ 08742; $25,000 for 6 months beginning September 1, 1980.

A need for reliable underwater communications in shallow waters exists. Applications include water quality monitoring, the study of fish life, the exploration of mineral resources, as well as salvage and rescue operations. Transmissions of data in shallow waters is more difficult than in the open seas. In shallow waters, communications are degraded by strong multipath signals, the presence of obstacles, man-made noise, and currents. These degradations sometimes totally obliterate underwater communications.

This study is to show the feasibility of using a spread-spectrum transmission format with fast Fourier transform processing for underwater links. Digitization of voice by Delta modulation and vocoder will be considered. Theoretical analyses and in-situ experiments will be performed to establish bandwidth, symbol rate and bit error constraints. This characterization is presently unavailable for shallow waters. The results will lead to conclusions about telemetry rates and voice transmission ranges. Present telemetry rates, limited to bit rates of tens of Hz, should be improved by at least an order of magnitude. Savings of dollars, manpower, and lives will result.

Feasibility Study — NMR Imaging Microscope; *Waylon V. House,* Intermagnetics General Corp., Guilderland, NY 12084; $23,900 for 6 months beginning September 1, 1980.

If the resolution of nuclear magnetic resonance (NMR) imaging of biological systems were improved, it could provide a capability of NMR microscopy. It would then become possible to examine individual cells and to explore on a cell-by-cell basis the functional differences between normal and abnormal cells for both research and diagnostics. It is anticipated that resolution can be substantially improved by applying NMR techniques to very small objects under magnetic field and frequency conditions not achievable for large objects.

This study will measure and quantify the influences of probe geometry for the very small dimensions required and of magnetic field strengths at the very high values necessary for maximum resolution, and explore the possibility of sharpening the resonance frequencies and improving resolution by stimulating the nuclei with appropriate time-dependent radio-frequency pulses.

Halocarbon Emulsion as Safe and Effective Hydrological Tracers; *Stephen L. Kerrin,* Energy Resources Co. Inc., La Jolla, CA 92037; $20,858 for 6 months beginning September 1, 1980.

The objective of this research is to determine the feasibility of using perflourinated hydrocarbons as water tracers. Three areas are being investigated: (1) analytical methodology, (2) retention of tracer by various soils and (3) emulsification characteristics of the tracer. A minimum of two of the following tracer candidates are being investigated: perfluorodecalin, perflourodimethylcyclohexane, perflourotributylamine and perflourodimethylcyclobutane. The goal is to obtain the optimum combination of tracer, surfactant and analytical methods for future field investigation.

Adaptive Welding System; *William J. Kerth,* Taylor Systems Engineering Inc., Fair Oaks, CA 05628; $24,849 for 6 months beginning September 1, 1980.

This project is directed to the use of optical techniques to guide an automatic welder.

The objectives of this research project are (1) to perform weld environment sensing using a light sectioning technique to obtain detailed weld seam information and (2) to demonstrate feasibility of preview control of the welding process.

The light sectioning method works by projecting a shadow at an angle to the surface of the weld seam. The resulting shadow pattern contains geometric information which is detected by a solid-state camera interfaced with a computer. The information is used in a computer-controlled welding system capable of selecting weld patterns which have been predetermined for the particular seam geometry.

Toughened Ceramic Adhesives for Structural Ceramics; *Henry P. Kirchner,* Ceramic Finishing Company, State College, PA; $24,917 for 6 months beginning September 1, 1980.

The feasibility of using toughened ceramic adhesives to join structural ceramics, such as hot pressed silicon nitride and alumina, will be investigated. Available toughening techniques include stress induced phase transformations, controlled microfracture, particle toughening by coherent precipitation or elongated particle pullout and ductile second phase networks. Joints prepared using these techniques will be evaluated using fracture mechanics methods such as double cantilever beam measurements of fracture toughness. These techniques have been developed and used successfully in research on organic adhesives. The factors influencing the degree of toughening and the feasibility of the combined use of toughened adhesives and compressive surface stresses over the joints will also be investigated. Availability of improved joining techniques for structural ceramics can be expected to aid substantially in promoting the use of structural ceramics by increasing the strength of the structures, by introduction of new options for design and by cost reduction.

Acoustic Concept for Measuring Particle Size Distributions; *David S. Mahler,* KLD Associates Inc., Huntington Stat., NY 11746; $25,000 for 6 months beginning September 1, 1980.

An important problem in air pollution control is the measurement of particulate emissions from power plants and other industrial processes. The small particles are recognized as most harmful since they readily enter the respiratory system and subject humans to toxic materials. Techniques to accurately monitor the size and distribution of these small particles (1 um and less) is a continuing requirement.

This research is for the feasibility study and evaluation of an acoustic method of measuring the size and concentration of small particles entrained in air. The technique, which has been investigated analytically, is based upon the changes in the speed of sound as caused by the presence of particles. The major objective of this research project is the experimental evaluation and verification of these concepts. Specifically, the results will be obtained with respect to (1) the measurement and resolution of mean particle size, (2) the measurement of total mass loading in the gas and (3) the variance of the particle distribution about its mean.

Enrichment of a Brackish Water Pond for Shellfish Culture: *George C. Matthiessen,* Ocean Pond Corporation, Fishers Island, NY 06390; $18,000 for 6 months beginning May 1, 1981.

A major constraint upon the culture of edible marine organisms on a commercial scale in most coastal states is the lack of availability of suitable culture areas. Many ecologically favorable areas of the coastline are closed to aquaculture as a result of zoning restriction, local ordinances, and social resistance. As a result, the only recourse for many aquaculture enterprises may be to develop highly intensive culture techniques in areas of limited size.

Ocean Pond Corporation has initiated experiments in the enrichment of a brackish water pond for the purpose of increasing the yield of American oysters (*Crassostrea virginica*). Preliminary small-scale experiments have indicated that the standing crop of phytoplankton, the primary source of oyster nutrition in the surface layers of the pond, may be increased by two orders of magnitude when enriched with bottom water. An artificial upwelling system to bring bottom water to the surface, will be installed by means of a wind-driven circulator, activated by a windmill. The objective is to determine if a significantly large area of the pond will show increased primary productivity, with significant benefits in terms of oyster growth rates and annual yields.

Electron Beam Lithography of Protein Monolayer, Ultrathin Composite Resist Films; *James H. McAlear,* EMV Associates Inc., Rockville,MD 20850; $24,305 for 6 months beginning September 1, 1980.

Packing density and speed of computing elements are directly related to the resolution achievable by a given lithographic approach. Ultimate computational capability of new, low heat dissipating or noise processes, such as CCD's, bubble memories or Josephson junctions, are limited in part to 2500A resolution provided by state-of-the-art electron beam or x-ray lithography. To produce lines substantially below this limit, novel approaches to resist materials and lithography are needed.

This research is aimed at demonstrating that high resolution (100A) masks can be achieved using ultrathin composite resist films. These films are formed by enveloping a protein monolayer with a resist on a support film and exposing the film with an electron beam so as to 1) minimize electron scatter effects and 2) allow chemical linking of active enzymes to the protein. These enzymes catalyze reactions that depost x-ray electron dense materials such as Pb, Ag, Ru and Te.

Protein affinity and enzyme-catalyzed reactions permit the specific deposition of many chemical elements, either individually or in combination. The implications of this approach include novel desposition capabilities, high resolution and potentially higher writing speeds. More significantly, however, is the possibility of developing these protein substrates into sepcifically oriented templates for the organization of protein macromolecules and other polymeric materials into functional elements of ultramicrodevices.

An Anthropometric Data Base for Commercial Design Applications; *John T. McConville,* Anthropology Research Project, Inc., Yellow Springs, OH 43587; $23,895 for 6 months beginning September 1, 1980.

This study is to determine the feasibility of an innovative approach for satisfying commercial needs for anthropometric data. The approach consists of obtaining the necessary information either by extrapolating it from existing primarily military data or by employing small-scale surveys tailored to specific commercial needs. Phase I is to determine 1) the extent to which military data can be used to represent civilian body size dimensions; 2) where gaps in the data occur; and 3) whether comparative subgroup analysis can effectively fill these gaps. If this phase is successfully accomplished, the resulting data will be tested in combination with small-scale sampling in Phase II to empirically validate the overall approach. If the usefulness of this approach is demonstrated, then the likelihood of commercial support for the establishment of an anthropometric design center which provides industrial users with valuable information in a usable form at a minimal cost is foreseen.

Investigation of the Super Plastic Drawing of Acrylic Fibers; *Daniel C. Nelson,* Fiber Materials, Inc., Biddeford, ME 04005; $23,900 for 6 months beginning September 1, 1980.

The objective of this research is to uncover new scientific facts necessary to commercialize small diameter oxidized polyacrylonitrile insulating fibers for use as a substitute for cancer causing asbestos in fire and heat protective clothing. A discovery was made during related research on graphite fibers that super-plastic deformation can occur during the oxidation of polyacrylonitrile (PAN) fibers. Small diameter oxidized PAN fibers can be made on an experimental basis from standard commercial fiber tows using super-plastic drawing techniques. Insufficient information is known at present to scale-up the potential super-plastic drawing process to the levels required. Specific objectives of this project are to determine the role of deformation of the oxygen content of the drawing furnace atmosphere, and the existence of a possible critical temperature range or critical fiber oxygen content. In addition, the possible role of oxidation reaction products as internal lubricants in the fibers during drawing will be studied.

Electrorefining of Aluminum; *J. P. Pemsler,* Castle Technology Corp., Lexington, MA 02173; $25,000 for 6 months beginning September 1, 1980.

Aluminum, a metal vital to the national interest, requires large amounts of energy to produce and will be in short supply in the 1980's. Increase recycle of aluminum will reduce import dependence and save large amounts of energy. Wrought aluminum is gaining in use relative to aluminum castings, but existing technology provides only for recycle of wrought scrap to the cast metal. The objective of this project is to investigate a novel, inexpensive, energy efficient approach to the electrorefining of contaminated wrought aluminum scrap that will result in a product suitable for recycle to wrought alloys. The method uses a low temperature aluminum chloride-sodium chloride electrolyte with a stable organic leveling agent to promote a dense adherent electrodeposit.

Research on the Feasibility of a Multi-channel Ultra-sensitive Analyzer for Mineral Resources; *Kenneth H. Purser,* General Ionex Corp., Newburyport, MA 01950; $25,000 for 6 months beginning September 1, 1980.

The project is for research into the feasibility of utilizing an ultra-sensitive mass spectrometer with a cesium beam sputter source to determine the concentrations of elements in a geologic sample. It is anticipated that concentrations as low as 10^{-11}, or one part in 100 billion, can be measured. By this technique, rapid simultaneous ultra-sensitive measurements of concentrations of the majority of elements in a very small mineral or rock sample can be accomplished. The energy distribution of a selection of negatively charged ions produced from samples under bombardment will be measured. The data obtained will be utilized to demonstrate the concept and determine design criteria for a final instrument package.

Hydrostatic Extrusion of In-Situ Process Superconductive Wire for Use in NMR Magnets; *Robert E. Schwall,* Intermagnetics General Corp., Guilderland, NY 12084; $23,900 for 6 months beginning September 1, 1980.

Intermagnetics General Corporation is studying hydrostatic extrusion as a method of preparing in-situ multifilamentary Nb_3Sn-Cu superconducting wire for use in very high frequency, high resolution NMR magnets.

At the present time, the in-situ process is limited to superconducting wires smaller than 0.38 mm in diameter because of the necessity to diffuse tin into the composite from the surface of the wire. This study circumvents this fundamental limitation by incorporating filaments of tin in the Cu-Nb billet. Because of the low melting point of the tin such a composite is not fabricable by conventional processing technology. The study is determining the feasibility of producing this material by hydrostatic extrusion whereby the tin is maintained in the solid state until the wire is drawn to final size. The wire is then reacted at high temperature to form the Nb_3Sn.

The objective is to offer a technology for producing at low cost, a high current density, high field conductor of low cost which will extend high resolution NMR persistent mode magnets beyond the present 500 MHz limit.

Off-shore Abalone Farm Research Project; *Nate Shafer,* Pacific Ocean Farms Ltd., Carmel Valley, CA 93924; $25,000 for 6 months beginning September 1, 1980.

This study will provide design solutions to various engineering and bio-engineering aspects of commercial red abalone culture in California. Habitats for the shellfish will be tested in 100-foot deep sites located 2½ miles offshore, where 30-foot waves are encountered. Habitat durability, safety techniques for abalone-removal, cost-effective procedures for predator removal and abalone harvesting, and related aspects will be analyzed. The research will be a valuable contribution to the Marine Farming field.

By-product Molybdenum Recovery; *Douglas Shaw,* Hazen Research Inc., Golden, CO 80401; $24,900 for 6 months beginning September 1, 1980.

In recent years, on-half of all the molybdenum contained in billions of tons of porphyry copper ore milled in the United States was routinely discharged to tailings areas.

The purpose of this Phase I research program is to develop a better understanding of the problems of by-product molybdenum flotation and, ultimately, to develop improved flotation conditions so that the recovery of this strategic metal can be increased.

The first part of the proposed work entails a detailed evaluation of selected U. S. copper-molybdenum ores and flotation tailings, using various physical, chemical, and optimal methods. With a clearer understanding of the characteristics and problems of by-product molybdenum flotation, various experimental methods for increasing recoveries will be developed and applied, in the laboratory, to several U. S. ores. Studies will include: coarse middling flotation from plant tailings, varying alkalinity, pulp dispersion techniques, and selected flocculation of sub-sieve size molybdenite.

Research on Acoustooptic Filter Side Lobe Suppression; *Leonard M. Smithline,* Lansing Research Corp., Ithaca, NY 14850; $24,829 for 6 months beginning September 1, 1980

A non-destructive, optical imaging microprobe operating in real time is of significant value for the study of materials including *in vitro* biological samples, semiconductors and VLSI structures. A tunable acoustooptic filter (TAOF) offers desirable operating characteristics as the key bandpass determining element in an instrument utilizing the Raman effect to identify molecular constituents. These characteristics include high optical throughput, random spectral access, polarization selectivity and optical clarity. The existence of side lobes on the TAOF optical transfer function is a problem in spectroscopy.

The proposed research undertakes appropriate mathematical analysis of the operation of a TAOF to yield an understanding of how to suppress the data orginating in side lobes. The objective is to obtain a mathematical formulation based upon both the theoretical side lobe characteristics and the measured characteristics of a real TAOF. This mathematical formulation is then incorporated in the operating program of a computer controlled TAOF experiment to test its effectiveness with monochromatic light sources. These results permit an assessment of how effectively the TAOF performs off-resonance rejection at varied spectral locations relative to the resonant main lobe.

Suspended Solids Removal Using Cross-flow, In-depth Filtration; *T. R. Sundaram,* T. S. Associates Inc., Columbia, MD 21044; $25,000 for 6 months beginning September 1, 1980.

Through-flow, in-depth filtration is a well known technique for the separation of suspended solids from fluid streams, with diatomaceous-earth and multi-media filters being examples. Another technique which is coming into increasing use in recent years is cross-flow filtration, an example of which is ultrafiltration with thin-skinned membranes. What does not appear to have been appreciated in the literature, however, is that many of the relatively thick filter media used in through-flow filtration may be equally well suited for use in the cross-flow filtration mode. Many of the techniques used in through-flow filtration, such as the addition of filter-aids in either a precoat or an additive mode, may also be quite effective in cross-flow filtration. Demonstration of the feasibility of the concept just noted will result in a technology for suspended solids separation which is efficient, relatively inexpensive, and has low energy requirements. The technology will be of considerable value in minicipal and industrial wastewater treatment as well as in many industrial processes.

In this project, the demonstration of feasibility will be accomplished through controlled small-scale, laboratory experiments on a range of commercially available filter media. Preliminary experiments have already shown the basic merit of the concept.

A Novel Superconducting Magnetometer with Quantum Noise Limited Sensitivity and Enhanced Coupling Properties; *Claudia D. Tesche,* Lutech Inc., Berkeley, CA 94701; $24,472 for 6 months beginning September 1, 1980.

Superconducting magnetometers (SQUIDs) are presently being used to make highly sensitive measurements of changes in magnetic flux. These devices find widespread application as magnetometers, gradiometers, susceptometers and linear current amplifiers in such diverse fields as geophysical exploration, materials analysis, magnetoencephalography, gravity wave detection and numerous others.

This study will analyze and test the feasibility of a novel superconducting magnetometer. The sensitivity of this device is expected to be on the order of 3-4 orders of magnitude more sensitive than the present generation of commercially available devices. In addition, the coupling properties of the device will be substantially enhanced. This is expected to significantly increase the range of application of magnetometers and linear amplifiers based on this device.

This design consists of a two-loop thin film structure incorporating two Josephson tunnel junctions. One loop will serve as a coupling loop with variable inductance chosen to optimally match the magnetometer to the source. The other double junction loop inductance will be reduced several orders of magnitude below the conventional dc SQUID loop inductance. As a result, these devices can be fabricated with conventional aperature mask technology. This permits the development of quantum noise limited devices with enhanced coupling properties by small, applications-oriented businesses.

RESEARCH INITIATION IN APPLIED SOCIAL & BEHAVIORAL SCIENCES

The Division of Applied Research issued an announcement in FY 1980 inviting young investigators in the social and behavioral sciences to submit proposals for applied research. Proposals were received from investigators in psychology (41), economics (39), political science (36), management and decision science (15), sociology (12), geography (7), anthropology (4), communications (4), and others (11). Of those, 10 awards went to investigators in psychology, 9 each to economics and political science and 6 to sociology, decision sciences and other disciplines.

Awards were limited in size to $35,000 and a duration of twenty-four months in order to encourage smaller scale projects and to permit adequate time for research to begin and for subsequent follow-up planning to occur.

Credit Rationing, Liquidity, and the Macroeconomy; *Ben Bernanke,* Stanford University, Sponsored Projects Office, Stanford, CA 94305; $27,933 for 12 months beginning July 15, 1980.

Credit markets are frequently observed to be "imperfect," in that consumers or firms cannot borrow as much as they would like at prevailing interest rates. Banks impose limits because they observe individual default probabilities imperfectly; without limits, self-selection of high-risk borrowers would destroy the market.

Credit rationing causes consumers and firms to be concerned with cash-flow management. Purchases of illiquid assets, like durables, become sensitive to the agent's liquidity position. This helps explain the sensitivity of durables demand to fluctuations in aggregate income and to the variability of inflation.

This research develops these propositions theoretically; empirical tests are also made, using data on aggregate balance sheets.

Effects of Personal Life Stress Upon Individual Performance Effectiveness and Work Adjustment Processes Within Organizational Settings; *Rabi S. Bhagat,* University of Texas at Dallas, School of Management and Administration, Richardson, TX 75080; $34,977 for 12 months beginning July 15, 1980.

Reviews of the literature on the relationship between work and non-work revealed that the empirical studies conducted on this important linkage has so far been concerned with the nature and consequences of work related outcomes on employees' non-work related experiences. With the exception of three empirical studies, the effects of personal life stress on individual effectiveness within work organizations have not been examined in sufficient detail. The literature review also failed to discover any kind of theoretical work linking employees' experienced personal life stress with the nature and quality of his or her organizational participation. An attempt is made to remedy this situation by proposing a comprehensive conceptual model that relates the effects of personal life stress on several different measures of individual effectiveness indicators of organizational participation. A detailed scheme of research investigation was developed with a view to generating some knowledge not currently available in the literature. Findings of this research investigation answer questions relating to some interesting and yet unexplored issues on the process of how individuals behave in their personal lives. Development of such a perspective should be an immediate concern of the field of industrial organizational psychology if we are to adequately embrace a sense of holistic concern for the employee, and not just the part of the employee which is concerned only with the quality of working life.

A Composite Model for Mobility and Migration Analysis and Conditional Population Projects; *Donald W. Chamberlayne,* Worcester Polytechnic Institute, Department of Social Science & Policy Studies, Worcester, MA 01609; $29,351 for 15 months beginning July 15, 1980.

The research seeks to extend existing techniques of analysis of population dynamics to sub-areas (census tract level) of urbanized regions as a means of assessing trends in intra-regional movements of age-(sex and race) specific population cohorts and rendering short-term conditional projections. Building upon currently available methods, it proposes for preliminary testing and refinement three new indicators of such dynamic processes: (1) an in-migration rate vector derived in the absence of direct census measures; (2) a fertility rate correction factor designed to bypass cumbersome and unreliable procedures of determining local variations from national fertility norms; and (3) an index of the degree of relative cohort "regeneration" occurring over time within local sub-areas. These techniques are combined in a composite-form aggregate model of local population dynamics comprising an extension and variation on known methods of conditional population projection, including "cohort-survival," derivation of net migration residuals, and the application of net migration rate "types" specific to areas of identifiable socio-demographic character. For preliminary testing of the model, population data for census tracts, towns, cities, and other aggregates of metropolitan regions of Worcester, Massachusetts and three other cities are to be employed.

Modeling Municipal Response to Revenue Constraints; *George Downs,* University of California-Davis, Department of Political Science, Davis, CA 95616; $34,893 for 24 months beginning July 15, 1980.

The capacity to predict the consequences of revenue loss from a given source on municipal fiscal behavior is quite limited for both formal revenue restrictions such as Proposition 13 and *de facto* losses brought about by economic decline. This study develops such a predictive capacity by evaluating the extent to which historical trends in revenue gathering and expenditure responses to declining fund availability is accessible to inferential model building using multivariate time series techniques. Data is drawn from two representative cities, Pittsburgh and San Diego.

Stress and Life Transitions in Childhood: Parental Divorce; *Robert D. Felner,* Yale University, Department of Psychology New Haven, CT 06520; $34,999 for 18 months beginning July 15, 1980.

Two studies are being conducted on those factors which facilitate a young child's successful adaptation to stressful life events generally, and specifically to parental divorce. The studies seek to identify sources of stress for these children during marital dissolution, environmental and personal factors that mediate the impact of the experience, and coping strategies and resources that are most effective in facilitating successful adaptation. Variations in the presence and impact of these stressors and mediator variables as a function of the child's age, sex, ethnic and socio-economic background and the type of child custody arrangement are explored. Study I employs a multimethod/multimeasure design focusing on a population of families chosen to include subjects from different levels of socio-economic and ethnic/racial backgrounds, as well as children of different developmental levels between infancy and twelve years of age. Study II focuses specifically on child custody arrangements as they modulate the presence and influence of mediating factors, coping patterns and resources of the child's adjustment. A prime focus throughout the study is the identification and clarification of those factors which may be used to inform the targeting, nature or implementation of primary prevention strategies for young children experiencing marital disruption and other similar stressful life events.

Public Service Provision on the Urban Fringe: Alternative Institutions and the Pattern of Development; *Peter S. Fisher,* University of Iowa, Department of Urban & Regional Planning, Iowa City, IA 52242; $34,952 for 13 months beginning July 15, 1980.

The objective of this research is to examine alternative institutions for the provision of certain services to residencies on the urban fringe and the implications of these alternatives for the spatial pattern of development and the distribution of service benefits and costs. The services examined are roads, water supply, and sewage disposal. The institutions range from private individual systems and homeowners' associations to special districts and city and county government. Actual historical development patterns in the Cedar Rapids, Iowa, metropolitan area between 1960 and 1980 are compared with two alternative hypothetical development sequences involving greater contiguity of development. Costs of providing the three services over the 20-year period are estimated. This permits an analysis of the cost savings resulting from the more compact development alternatives considering both the timing of development and of infrastructure investment and the institutional context of urban growth. The share of costs borne by the fringe resident can then be separated from the share shifted onto city and county residents generally. The results are expected to have significant implications for city growth management policies and utility pricing practices, annexation policy, and policies with respect to regulation and use of private service systems and special districts.

Effect of Tax Subsidies on Subnational Fiscal Behavior; *Ronald C. Fisher,* Michigan State University, Department of Economics, East Lansing, MI 48824; $29,042 for 14 months beginning July 15, 1980.

The objectives of this research are (1) to specify a model of the effects of credits or deductions against one government's tax for taxes paid to a lower level of government on subnational public expenditures and taxes, (2) to describe the current distribution of benefits from these intergovernmental tax credits and deductions, and (3) to estimate the incentive effects of federal income tax deductibility of state and local taxes and of state tax credits or rebates for local property taxes.

Results are obtained by cross-section analysis of subnational government tax and expenditure decisions related to the magnitude of these tax subsidies and other economic variables. These results partly explain the current distribution of subnational government taxes and the growth in subnational public expenditures. In addition, these results are necessary to predict the effects of changes in these deductions or credits and may suggest ways of altering the distribution of tax burdens and achieving more efficient use of resources.

Adaptation to and Evaluation of Visual Features in the Urban Environment; *Daniel M. Geller,* Georgetown University, Department of Psychology, Washington, DC 20057; $32,649 for 18 months beginning July 15, 1980.

Unlike the natural environment, the built environment of cities is constructed by people. Given control over the environment in which people live and work, an opportunity exists to examine systematically how people react to different kinds of environments. This project conceptualizes people's affective responses in terms of complexity and novelty of the visual environments. Theories allow one to test how these variables influence people's reactions. In this study the theories examine arousal-seeking tendencies and adaptation level in relation to the effective responses. The results of this study will provide city designers with classes of data on which to base planning of building in cities.

Risk Premiums, Innovations and Multiple Currencies in the Foreign Exchange Market; *Craig S. Hakkio,* Northwestern University, Department of Economics, Evanston,IL 60201; $34,983 for 24 months beginning July 15, 1980.

The project attempts to examine three factors affecting the short run behavior of exchange rates. Recent research has led to the conclusion that exchange rate variability is, at least in part, a reflection of new information concerning the future. In testing the "efficient market" theories, indications of inefficiency have appeared. As with all such tests, a joint hypothesis is being tested: market efficiency and a particular model. The basic premise underlying this proposal is that the simple models currently being used could be usefully extended in various dimensions.

Three such extensions are considered. The first extension is to develop a model and estimation procedure that allows for the risk premium to vary over time. The second extension is an examination of the effect of current account innovations and money supply innovations on the forecasting of spot exchange rates. The third extension considers the implication of world-wide shocks (the oil crises of 1973 and 1979) and multiple currencies for forecasting exchange rates. Knowledge of the structure of these shocks and cross-exchange-rate restrictions lead to an improvement in our predictions of future exchange rates.

Bilingualism, Cognitive Flexibility, and Social-Cognitive Skills in Children; *Kenji Hakuta,* Yale University, Department of Psychology, New Haven, CT 06520; $35,000 for 15 months beginning July 15, 1980.

Many recent studies have argued that the process of becoming bilingual under certain circumstances enhances the individual's cognitive flexibility. In addition, several studies indicate a link between cognitive flexibility and social-cognitive skills in children. However, since most studies compared the bilinguals to a monolingual sample, it is unclear whether the specifically linguistic aspects of bilingualism influence cognition. Bilinguals and monolinguals inevitably differ in variables other than the number of languages they speak. Furthermore, since there have been no longitudinal studies, the direction of causality between the variables has not been adequately assessed. To understand the role of language in the cognitive consequences of bilingualism, and to establish a link with social-cognitive skills, a longitudinal study comparing individuals within a sample of 150 bilingual Spanish/English children (Grades K-1) is being conducted. Variability in language ability is compared to variability in cognitive tasks. To promote ecological validity of the language measure, an assessment battery that correlates with spontaneous speech ability is being developed at the beginning of the study. Individual differences between bilinguals is the primary focus of exploratory data analysis to help provide a taxonomy of children in bilingual programs for future research.

A Multi-Methodological Investigation of the Impact of Media on Perceptions of Crime; *Linda Heath,* University of Minnesota, Department of Criminal Justice Studies, Minneapolis, MN 55455; $35,000 for 14 months beginning July 15, 1980.

In this research the effects of sensationalism and controllability of crime presentations in newspapers and on television on people's perceptions of crime are investigated with a telephone survey and an experiment. Respondents for the telephone survey are randomly chosen from cities which differ in their crime rates and in the degree of sensationalism and the amount of controllability of crimes evidenced in the local newspaper (as determined by a content analysis). Respondents are further sub-divided according to self-reports of their television viewing and newspaper reading habits. Relationships among the above variables and respondents' perceptions of crime and fear of crime are examined. In the laboratory experiment, respondents read accounts of crimes which differ in the degree of sensationalism, controllability, and similarity of the victim to the respondent. Self-reports of fear and behavioral observations of anxiety are examined in relation to the above variables. This research is an important step in developing a research base that informs policy makers concerning the role of the media in the creation of fear of crime.

The Forward Foreign Exchange Market: Some Econometric Tests of Market Efficiency; *Robert J. Hodrick,* Carnegie-Mellon University, Graduate School of Industrial Administration, Pittsburgh, PA 15213; $26,358 for 6 months beginning July 15, 1980.

Considerable debate is occurring in business, academic and government circles regarding the functioning of the foreign exchange market and the appropriateness of various government policies. Some advocates of flexible exchange rates have argued that the forward exchange market will be efficient if the forward rate is the market's conditional expectation of the future spot rate. Recent research demonstrates that this simple notion of efficiency can be rejected by the data. More complex theoretical models demonstrate that significant risk premia can develop in markets with risk averse economic agents implying that there will be nonzero expected returns to speculation in the forward market. This research seeks to characterize and test the validity of the restrictions that the more complex notions of efficiency imply for the rates of return to speculation in the forward markets of the major world currencies.

If the debates on government policies such as the choice of fixed vs. flexible exchange rates or the need for government intervention in the forward market are to be conducted in an enlightened way, the nature of the efficiency of the forward foreign exchange market must be addressed.

Housing, Lending Institutions and Public Policy; *Richard C. Hula,* University of Maryland, Department of Family and Community Development, College Park, MD 20742; $34,966 for 12 months beginning July 15, 1980.

Claims that there exists a maldistribution of credit (thus the need for political intervention) rely at least implicitly on some notion of what a proper distribution of credit would be. This research develops a series of alternative conceptions or models of the home credit market. From each model a predicted geographic distribution of credit is calculated. Each of these estimated distributions is compared to the actual distribution of home credit in Dallas County Texas for the years 1970-1979. With this empirical base two policy issues are examined. First, is there justification for increased political intervention in the home mortgage and home loan market? Second, how one can evaluate possible strategies for increasing the flow of private credit to selected urban neighborhoods?

Spatial Cognition and Spatial Behavior in the Elderly: Implications for Learning New Spatial Environments; *Kathleen C. Kirasic,* Old Dominion University, Department of Psychology, Norfolk, VA 23508; $31,360 for 24 months beginning July 15, 1980.

These studies are an initial step towards the objective of alleviating the problems encountered by the elderly when learning new spatial environments. They are designed specifically to delineate the relationship between spatial cognition and spatial behavior in young and elderly individuals in a three-part procedure including a) psychometric tests of spatial abilities, b) controlled observation of behavior in familiar and unfamiliar spatial visualization, spatial orientation, and visual scanning and memory abilities. The behavioral observations are made in the ecologically valid setting of familiar and unfamiliar supermarkets. The experimental tasks, which involve spatial information from the supermarket settings, include scene recognition, route planning, and knowledge of spatial relations.

The results of these studies highlight differences in spatial behavior between young and elderly adults and indicate cognitive factors responsible for or related to these differences. This information will be applied toward the development of methods to assist the elderly in learning new spatial surroundings following relocation to a new area or changes in familiar areas. In addition, these findings provide insight into the competence-performance distinction as applied to the issue of cognitive functioning in elderly individuals.

Causes and Consequences of Supervisory Performance Feedback; *James R. Larson,* Barnard College, Department of Psychology, New York, NY 10027; $35,000 for 20 months beginning September 1, 1980.

Performance feedback is a critical factor for maintaining the work effectiveness of individuals and groups in organizations. Performance feedback frequently comes from one's immediate supervisor, and often occurs in the context of everyday supervisor-subordinate interactions. The purpose of the research proposed here is to discover those variables that influence the likelihood that supervisors will give performance feedback to their subordinates, and to determine the effects that giving subordinates performance feedback have on the supervisor him/herself. Two laboratory experiments examine the degree to which supervisors' likelihood of giving performance feedback is influenced by 1) the valence of the subordinate's performance, 2) the degree to which the subordinate is perceived to be personally responsible for that performance, 3) the supervisor's affect toward the subordinate, or 4) the degree to which the supervisor's job rewards are dependent upon the subordinate's performance. A third study investigates the effects of performance feedback on supervisors' self-perceptions and their perception of their subordinates. This resarch has the potential for making a significant contribution to both our understanding of the overall feedback process, which should ultimately help us improve performance in organization, and our understanding of factors that contribute to supervisors' job stress.

Divorcing Parents: Decisions About Child Custody and Attitudes Toward Court Alternatives; *Carol R. Lowery,* University of Kentucky, Department of Psychology, Lexington, KY 40506; $35,000 for 22 months beginning July 15, 1980.

Increasing numbers of parents are faced with the difficult decision as to which of them will take primary custody of their children as they get a divorce. The court usually assumes that if parents reach an agreement about custody, their decision reflects the best interests of the children. At present, very little is known about how parents decide custody. Both legal and mental health professions have suggested that the final custody decision should be taken out of the context of adversary court proceedings. The argument has been offered that adversary proceedings enhance conflict between the parents, jeopardizing their parental relationship which continues after their marital relationship has been dissolved. The children are then stressed by parental conflict that continues after the divorce.

The present study is designed to examine 1) the process and the criteria used by divorcing parents to decide custody and 2) parents' attitudes toward alternatives to the courtroom for that decision. The results will be used to provide a basis for assessing 1) the adequacy of parents' decisions and 2) their likely reaction to each of several changes in court procedures being proposed by child-advocates.

The Extent of Economies of Vertical Integration in the Oil Industry; *Mark E. McBride,* Tulane University, Department of Economics, New Orleans, LA 70118; $33,422 for 24 months beginning July 15, 1980.

The research project examines the extent of economies of vertical integration in the oil industry. The project develops a theoretical model of the sufficient conditions for an integrated firm's cost function to exhibit the concept of economies of integration. The theoretical model is based upon the economic theory of multiple output cost functions. The theoretical model is empirically tested with data from the oil industry. The necessary data to do the empirical work is contained in the Financial Reporting System overseen by the Energy Information Administration of the Department of Energy. The empirical results provide information of value to policy analysts dealing with proposed oil divestiture legislation.

Local District Implementation of State School Finance Reform: Political and Economic Factors Affecting Educational Equity and Governance; *Edward P. Morgan,* Lehigh University, Department of Government, Bethelehem, PA 18015; $34,993 for 24 months beginning July 15, 1980.

The research examines local school district implementation of state school finance reform, tracking each school district as a distinct political system of local political demands, wealth capabilities and demographic characteristics, political process of governance traits, and local policy decisions related to educational spending and taxation.

The analysis uses a model of intergovernmental implementation, incorporating determinants of local district responses to new state aid generated by school finance reform, statistical analysis of local district behavior and descriptive analysis of state-level factors in Massachusetts over a period of several years. The State of Massachusetts was selected because new school finance legislation was passed in 1978, a "cap" on local spending was passed in 1979, and Massachusetts data lend themselves to the study of local district political factors.

Juror Reactions to Variations in Courtroom Speech; *Michael G. Parkinson,* Southern Illinois University-Carbondale, Department of Speech Communication, Carbondale, IL 62901; $33,038 for 24 months beginning July 15, 1980.

The research advanced in this award includes two stages: First, speech style variables used successfully in prior research by the author into criminal trial behavior will be used as predictor variables in multiple discriminant analyses (MDAs) of the speech of plaintiffs' attorneys, defendants' attorneys, plantiffs and defendants. These MDAs will identify those characteristics of speech which co-occur with success in the civil trial. The speech samples used in these analyses will be drawn from the transcripts of actual civil trials.

The second stage will involve the reproduction, on video tape, of the transcribed civil trials. Some of these reproductions will contain modification of participant speech styles. By taking these reproductions to subject juries and comparing verdicts and other jury reactions it will be possible to confirm the causal impact of language style on verdict while holding all other trial variables constant.

The purpose of this award is to expand an earlier study of criminal trial speech into the civil milieu and to demonstrate that language variations have a causal impact on the outcome of trials. The ultimate objective of the line of research is the production of speech guidelines that may be used to increase efficiency, accuracy and fairness in trials.

Corporate Regulatory Compliance; *John T. Scholz,* State University of New York-Stony Brook, Department of Political Science, Long Island, NY 11794; $34,949 for 12 months beginning July 15, 1980.

Explanations of corporate legal behavior generally emphasize either an economic, sociological, or organizational perspective. These three kinds of explanations, when applied to corporate compliance with government regulations, have important but *contradictory* implications for the enforcement strategies of regulatory agencies. Although research has demonstrated the importance of each perspective, no theoretical framework has been developed to incorporate all three and thus resolve the contradictory implications. In addition, no agreed standards exist for measuring the cost, attitudinal, and capability variables presumed to determine corporate compliance.

This project extends theories of organizational decision-making to the compliance process in order to integrate the three sets of factors and develop consistent hypotheses concerning the effectiveness of enforcement strategies. Data will be gathered from corporate decision processes for regulations selected to represent a range of enforcement problems, using elite and other qualitative research techniques to develop several comparable studies of typical compliance processes. In addition, the project will compile a catalogue of possible indicators and techniques to measure relevant cost, attitudinal and capability variables and analyze their utility in explaining the observed compliance processes. The purpose is to develop reliable indicators which could be used by researchers to test the theory in a broader setting and by corporate and regulatory officials to analyze compliance problems and effective enforcement responses.

Development of Children's Arithmetic Self-efficacy: The Roles of Overt Verbalization and Goal Setting; *Dale H. Schunk,* University of Houston Central Campus, Department of Education, Houston, TX 77004; $22,703 for 12 months beginning October 1, 1980.

The object of this work is to determine the extent to which children's perceptions of their competence (self-efficacy) influence their acquisition of arithmetic skills. All children receive instruction in division and then attempt to solve problems. In the first study, children solve problems while verbalizing solution strategies, verbalizing spontaneously, or doing no verbalizing. In the second study, they solve problems viewing the goal perceived either as difficult or as easy to attain, or with no goal. A multi-ethnic sample of 60 children of both sexes (median 9.5 years) will be identified by teachers in several Houston metropolitan area schools as low achievers in arithmetic. Following a pretest assessing division skill, persistence, and self-efficacy, children are randomly assigned to conditions (3 per experiment, 10 children per condition). Then children individually receive three 45-minute sessions, each consisting of adult instruction and self-directed practice. Posttesting and a behavioral-interest test follow the third session. This research should answer questions such as: How well do changes in self-efficacy correspond to changes in subsequent performance? Does verbalization in the context of instruction benefit skill acquisition? Can relative performance information influence performance in a skill-development setting?

An Assessment of Union-Management Cooperation and its Impact on Productivity, Employment, and Other Indices of Organizational Effectiveness; *Michael H. Schuster,* Syracuse University, School of Management, Syracuse, NY 13210; $34,973 for 18 months beginning July 15, 1980.

This research is a field study that examines the effectiveness of joint union-management productivity programs. Although taking various forms, these programs can essentially be classified as Scanlon Plans, Rucker Plans, Impro-Share Plans, and plant-wide committees. A matched sample of some 10 unionized firms with cooperative productivity programs and 10 unionized firms without cooperative productivity programs are analyzed using an interrupted time-series design. Six effectiveness criteria are used-productivity, employment, absenteeism, turnover, tardiness, and grievances. The study also examines five determinants of program effectiveness — guarantees of employment security, participatory structure, compensation methodology, and effective acceptance strategy, and technology.

The Administration of Public Policy Decisions in Rural County Government Institutions; *James H. Seroka,* Southern Illinois University - Carbondale, Department of Political Science, Carbondale, IL 62901; $33,839 for 23 months beginning July 15, 1980.

The objective of this study is to develop and to test a model of public policy decision-making in rural county government institutions. This includes the measurement and description of rural administrators attitudes towards innovation, autonomy, federalism, planning, and regional cooperation; rural administration policy outputs; factors such as outside participants, socio-economic, political and cultural variables, and political processes; and changes in the model across various stages of the policy process. The procedures include a series of in-depth interviews and observation of the behavior of a select group of rural county administrators, a survey of a larger group of rural county administrators and decision-makers from a select group of states, and an economic analysis of the public policy outputs from non-metropolitan counties.

Staff Burnout and Turnover in Child Care Agencies: Job Stress, Psychological Strain, and Coping Responses; *Marybeth Shinn,* New York University, Department of Psychology, New York, NY 10003; $34,941 for 12 months beginning July 15, 1980.

This is a study of the causes and consequences of staff "burnout" and job turnover among child care workers in the context of a theoretical model of job stress, worker strain, and coping responses. Both burnout and turnover are critical problems for the human services. They are debilitating to workers, detrimental to clients, and costly to agencies. Both are so common among residential child care programs as to endanger the viability and effectiveness of these important alternatives to institutions for youths. The ultimate goal of this research is to aid agencies to reduce burnout and turnover by identifying stressors in the work environment that lead to psychological strain and coping strategies that reduce it. Coping is studied at the individual level (e.g., withdrawal), at the group level (e.g., social support) and at the level of the organization (e.g., structural change). The research involves in-depth interviews with two groups of child care workers: those leaving their agencies and those coping particularly well. Workers are asked about seven categories of job stress, including stressful job events and ongoing stressors, psychological strain, coping responses, performance, and turnover. Supervisors also rate workers' strain and performance. Tests of the theoretical model with all 80 workers, and comparison of the two subsamples, should increase our understanding of the stressors that lead to burnout and turnover and coping strategies that individuals, groups of workers, and agencies can use to combat it.

Estimation of Specific Factor Productivity and Efficiency for the U. S. Airlines: 1968-1979; *Robin C. Sickles,* University of Pennsylvania, Department of Economics, Philadelphia, PA 19104; $35,000 for 24 months beginning July 15, 1980.

The purpose of this study is two-fold. The first is to complete assembly of a set of panel data on the largest eighteen U.S. airline companies from 1969-1979. Quarterly observations on the several outputs of the multiproduct airline firm and output prices, data on major input categories of labor, capital, energy, and materials, and prices will be formed from detailed firm accounting data. The second task is to impose several different model structures on the data set in order to examine important policy issues dealing with specific factor productivity changes during the pre- and postregulatory environment, the degree to which firms are efficient in allocating resources and the costs of the inefficiencies, and whether or not these inefficiencies are related to regulatory constraints. Specific factor productivity growth rates are estimated using a translog cost function to model the underlying technology of the representative firm. Factor augmentation, or alternatively specific factor productivity growth has a dual representation as the (negative) growth in factor price dimunition which can be estimated from the cost function. Estimates of inefficiencies are derived from a Generalized Leontief profit function in which inefficiencies associated with incorrect input combinations and output mix and level of operations are parameterized.

The modeling methodology outlined above and the results of imposing these structures on the airline data set encourage similar firm studies. Additional information in other industries and a general consensus of results have an important bearing on the legislative mentality towards regulation and focus attention on which factors of production are lagging in their contribution to productivity growth.

An Experimental Study Testing the Effects of Cognitive Developmental Stage on Children's Perceptions of Product Packaging; *Gary F. Soldow,* City University of New York - Baruch College, Department of Communications and Marketing, New York, NY 10010; $34,758 for 12 months beginning July 15, 1980.

The research is concerned with expanding our understanding of the capabilities of children as they deal with the marketplace. Thus far, research toward this goal has utilized developmental theory in making predictions and providing explanations of children's perceptions of television advertising. Continuing with the implicit notion that children are consumers, the research expands this application to another aspect of the marketing context: product packaging. The package can be the major determinant of actual purchase behavior. The relationships among packages can vary with respect to spatial position on a shelf, size of the actual package as compared to size of object in the package, complexity of graphic material on the package, size or number of packages as a function of purchase needs, and similarity of actual package design to package design viewed in other mass media contexts such as television. Substituting product packages for objects used in classic Piagetian conservation tasks, the research examines how cognitive developmental stage influences perceptions of each of the above-mentioned aspects of packages. The results are relevant to federal and local agencies such as the Federal Trade Commission, private consumer agencies, academicians, marketers and advertisers, educators and the general public.

Exploration and Evaluation-Choice in Judgmental Decision Making; *Stephen A. Stumpf,* New York University, Graduate School of Business Administration, New York, NY 10003; $34,995 for 12 months beginning October 1, 1980.

The project objectives are: 1) to understand and describe exploration and evaluation-choice processes in judgmental situation, and 2) to determine if different exploration and/or evaluation-choice processes affect the quality of the decision and perceived effectiveness of the resulting outcomes. Several dimensions of exploration (e.g., intended-systematic, environment-oriented, self-oriented, directedness) and models of evaluation-choice processes (e.g., maximizing, satisficing, elimination-by-aspects, lexicographic) are operationalized and examined at five different times for 60 individuals making a career decision. Six types of variables are collected by structured interviews, questionnaires, or participant diaries over one year: individual background characteristics, personality and values variables, career expectations and anchors, decision exploration behavior, career preferences and evaluation-choice processes, and decision outcomes. The results of this project should increase the understanding of exploration and evaluation choice processes, their relationships to each other, and the effects of process on outcomes. The knowledge required through studying predecisional behavior and cognitive decision processes can be applied to educational and training programs designed to improve individual decision-making and to the design of computer assisted information systems which categorize and store information for future retrieval.

The Organizational Context of Sex Discrimination in Universities and Colleges; Robert F. Szafran, University of Iowa, Department of Sociology, Iowa City, IA 52242; $35,000 for 22 months beginning July 15, 1980.

The purpose of the research is to determine the extent and nature of sex discrimination in college and university faculty recruitment and reward. Data for the analysis comes from three separate studies of colleges and college faculties conducted between 1967 and 1969 and also from published records and descriptions. The first part of the study involves determining the extent to which the sex composition of recently hired faculty at the school varies from the sex composition of the available labor pool and determining the extent of male/female differences in salary, rank, and tenure net of differences in qualifications. In the second part of the study, characteristics of the organization's administrative and political structure as well as the organization's economic and political environment are systematically investigated for links with sex biases. The project will contribute to the understanding of organizational status attainment processes and also be of practical significance to administrators in efficiently directing resources to prevent sex discrimination.

Control of Externality — The Case of Trespass Laws; *Kenneth R. Vogel,* State University of New York - Buffalo, NY 14260; $34,134 for 18 months beginning July 1, 1980.

Current economic theory asserts that in a world with no transaction costs, any complete system of property rights will yield the same efficient equilibrium. Yet, if amount of production and externalities transacting must be done in unit prices, this result does not hold, and only the property rights system which gives receptors of externalities the right to be free from them will be efficient. The trespass by animals onto neighbor's farmland is an instance of externality, with very low transaction costs, where there are two distinct property rules in the United States. The common-law rule forbids trespass by animals, while statutory fence laws allow animals to wander onto any unfenced land.

This difference in law allows a test to be made of the proposition that both rules yield the same efficient equilibrium. California, which had the statutory rule until 1915 but shifted to the common law rule, should provide a basis for studying the effect of the change in law.

Interagency Coordination for Client Processing: A Study of the Implementation and Impact of the Washington State Involuntary Treatment Act; *Richard A. Weatherley,* University of Washington, School of Social Work, Seattle, WA 98195; $34,996 for 14 months beginning July 15, 1980.

This study examines the impact of the Washington Involuntary Treatment Act on clients and implementing agencies in view of the 1979 amendments broadening the criteria for detainment of mentally disordered persons. Qualitative techniques are employed to study the processing of clients in one urban and two rural counties. The law presupposes the close cooperation of what are in fact independent and sometimes antagonistic organizations. The study considers the effects of professional ideologies, statuses, and roles, organizational missions, and resource constraints on policy implementation. It traces the experience of clients as they are passed through the system; and it examines the role of the front line professional and semi-professional workers in client processing and treatment. The mutual adaptations of workers at the organizational boundaries are investigated to assess the relative salience of informal and formal coordinating mechanisms in policy implementation.

Comparisons of Cognitive Map Accuracy and Effective State; *Michael J. White*, Ball State University, Counseling Psychology & Guidance Services, Muncie, IN 47306; $33,808 for 12 months beginning September 1, 1980.

The hypothesized association of cognitive map accuracy and affective state is examined. The influence of various demographic covariates on this relationship, including age, income, and occupation is also studied. The interaction of these variables is observed in normal, institutionalized aged, and physically disabled populations.

Thirty randomly selected street intersections in a medium-sized city are being videotaped. These intersections and 10 prominent landmarks are being shown to 600 residents of the city. Accuracy of identification of intersections and landmarks are used to assess quality of the cognitive maps (i.e., internal representations of the physical environment) held by residents. Residents also anonymously provide demographic data and complete standardized psychological assessment instruments measuring anxiety, mood state, locus of control, and satisfaction with the city. The multiple regressions of cognitive map accuracy on measures of affective state were calculated, as are regressions of demographic variables and physical mobility on cognitive map accuracy.

Inferential and descriptive data contribute to comparative study of cognitive mapping, examine the influence of cognitive map quality on perceived control and affective state, assist urban planning, and initiate study of environmental perception among the physically immobile.

The Classification and Politics of Tax Expenditures; *John F. Witte*, University of Wisconsin-Madison, Department of Political Sciences, Madison, WI 53706; $34,967 for 24 months beginning July 15, 1980.

This study has two interrelated parts. The first is intended to provide a comprehensive description and classification for what has been defined in Federal statutes as the "tax expenditure budget." This project classifies and describes these revenue provisions by their current aggregate revenue effects, the number of taxpayers involved, the substantive area of the expenditure, the rational for the provision, and the distribution of benefits by income group. The second portion of the study, relying heavily on an historical data base, describes the general development of the tax expenditure system, and analyzes the political actors and institutions involved. Being sensitive to the different classifications of tax expenditures, differences in party behavior, presidential and various aspects of congressional treatment of revenue measures are studied. The objectives are to assess how tax expenditures originate, why they are increasing, who shares the responsibility, and the prospects for containment in the future. Both parts of the research will facilitate an evaluation of various recommendations for handling the expenditure "problem."

A Socioeconomic Analysis of Ethnic Enterprise; *Philip K. Young*, Pace University, Department of Social Sciences, Pleasantville, NY 10570; $29,247 for 12 months beginning September 1, 1980.

The project explores the social, demographic, and economic determinants of success/failure of small business owned by recent immigrants to the U.S. Primary data will be generated by a survey of Korean and Hispanic entrepreneurs, and of demographic characteristics of locations in which they are found. Issues such as the theory of small firms, employment of ethnic minorities, and the success of government practices and programs to assist small business will also be explored.

Optimal Tax Reform: Dynamic Aspects of Implementation; *George Zodrow*, Rice University, Department of Economics, Houston, TX 77001; $32,294 for 14 months beginning July 15, 1980.

The focus of the proposed research is the construction of an analytical framework which can be used to determine the optimal implementation of tax reform proposals which are desirable on allocative efficiency grounds. The central issue is the social evaluation of a fundamental efficiency-equity tradeoff associated with the enactment of tax reform. Specifically, immediate enactment of reform is desirable on efficiency grounds if implementation would improve the allocation of resources in an economy, but postponed or phased-in enactment of full or partial reform is desirable on equity grounds in order to reduce the arbitrary redistributions of income which accompany unexpected changes in a tax structure. Postponed enactment of full reform has been advocated in the literature as one method of resolving this efficiency-equity tradeoff.

The proposal uses non-linear optimal control methods to compute the optimal time path of tax reform. The optimization procedure determines values for the exogenous tax variables through time, chosen to maximize a social objective function which aggregates the individual utility changes associated with each time path of reform, subject to the constraints of a general equilibrium model of the economy to be studied. This analysis permits comparison of the relative merits of postponement and alternative implementation options, including immediate or phase-in enactment of full or partial reform.

APPENDIX

DIVISION OF APPLIED RESEARCH

PUBLIC POLICY AND REGULATION PROGRAM ELEMENT

Principal Investigator/ Institution	*Title of Project*	*Amount*	*Effective Date/Award Duration*	*Page*
Steven J. Brams New York University	Approval Voting: Applied Research & Utilization	$87,611	7/15/80 26 months	9
Robert Buckhout CUNY-Brooklyn College	Hypnosis, Hypermnesia and the Eyewitness	$106,366	8/15/80 24 months	10
Maureen L. Cropper University of Maryland	Valuing the Health Effects of Air Pollution	$43,803	8/1/80	10
Dale W. Jorgenson Harvard University	Energy and Economic Growth in the U.S. and Japan	$85,195	7/15/80 12 months	10
Elizabeth F. Loftus University of Washington	Improving Jury Instructions	$156,357	9/1/80 24 months	10
Barry Mahoney Inst. for Court Management	Evaluation of Telephone Conferencing to Conduct	$29,880	4/15/80 10 months	10
F. E. McGovern Samford University	Use of Experts by Alabama Supreme Court	$130,000	10/1/80 24 months	11
George L. Perry Brookings Institution	The Brookings Panel on Economic Activity	$75,000	9/1/80 12 months	11
Anna J. Schwartz NBER	The International Transmission of Inflation Through the World Monetary System	$120,873	3/15/80 18 months	11
Herbert Weisberg Analysis & Inference Inc.	The Application of Modern Statistical Principles to Automobile Insurance Risk Classification	$109,329	9/15/80	11

PUBLIC SERVICE DELIVERY AND URBAN PROBLEMS PROGRAM ELEMENT

Thomas J. Anton University of Michigan	Tracking the Intergovernmental Fiscal System	$96,102	4/1/80 12 months	12
Sandra L. Kirmeyer Cornell University	Employee Reactions to Job Demands in Service Settings	$42,775	9/1/80 12 months	12
E. S. Savas Columbia University	The Organization of Service Delivery: Recyling, Resource Recovery, and Solid Waste Disposal	$168,219	4/1/80 24 months	12
John B. Shoven NBER	Private and Public Pensions	$124,763	10/1/80 12 months	12

INDUSTRIAL ORGANIZATIONS AND MARKETS PROGRAM ELEMENT

William T. Bielby University of California at Santa Barbara	Jobs, Firms and Industries: Economic "Dualism" and The Organization of Work	$77,441	4/15/80 12 months	13
Ronald G. Ehrenberg Cornell University	Unions and Productivity in the Public Sector	$50,455	9/1/80 18 months	13
Edgar L. Feige Universtiy of Wisonsin-Madison	Empirical Analysis of Resource Scarcity and the Efficient Intertemporal Allocation of Exhaustible Resource	$86,842	6/1/80 15 months	13
Daniel S. Hamermesh NBER	Consumption, Retirement and Changing Life Expectancies	$48,281	9/1/80 18 months	14
Christopher Winship Nat'l Opinion Res.	Job Mobility and Youth Employment	$105,863	4/1/80 24 months	14

INDIVIDUALS AND GROUP PROCESSES ELEMENT

John E. Adams University of Minnesota-Duluth	Attitudes Determining Food Choices	$68,595	9/1/80 14 months	14
Martin Deutsch New York University	Long-Term Effects of Early Intervention on Children	$108,843	1/1/80	14

Principal Investigator/ Institution	*Title of Project*	*Amount*	*Effective Date/Award Duration*	*Page*
Barbara S. Dohrenwend Columbia University	Traits, States, and Life Events	$97,402	10/1/80 24 months	15
Bernard Mausner Beaver College	Socialization of Achieving Behavior in Men and Women	$149,724	9/1/80 36 months	15
Mark S. Mayzner Loyola University-Chicago	A Technology for Increasing the Discriminability of Symbol Sets	$150,000	5/1/80 36 months	15
Karl M. Newell University of Illinois Urbana	Kinematic and Kinetic Parameters as Information Feedback in Motor Skill Learning	$149,988	10/1/80 36 months	15
Eli Saltz Wayne State University	Improving Acquisition and Memory in Young Children and Older Adults	$125,132	6/1/80 36 months	16
Charles V. Vorhees Childrens Hospital Research Foundation	An Experimental Investigation of the Behavioral Teratogenic Effects of Exposure to Anticonvulsant Drugs	$124,744	3/15/80 24 months	16

PHYSICAL, MATHEMATICAL, AND ENGINEERING APPLICATIONS PROGRAM ELEMENT

George R. Bird Rutgers University	New Families of Chromophores for Broad-Band Lasing Action, for Improved Long Wavelength Performance, and for Gas Phase Lasers	$179,680	4/1/80 36 months	17
James A. Browning Browning Engineering Corp.	Extreme Impact Velocity Meral and Ceramic Disposition	$100,000	10/1/80 18 months	18
James W. Evans University of California-Berkeley	An Investigation of an Improved Electrode (The Fluidized Bed Electrode) for the Production of Cobalt by Electrowinning	$57,242	9/1/80 12 months	18
James Glimm Rockefeller University	Mathematics Applied to Theoretical Physics, Engineering and Biology	$50,000	9/1/80 24 months	18
Gershon M. Goldberg Lonomet Company	High Speed UV and Electron Resist Systems	$91,433	10/1/80 24 months	18
Joseph P. Gould Georgia Inst. of Tech.	Products of the Chlorination and Ozonolysis of Synthetic Dyes	$134,202	9/1/80 24 months	18
Hermann A. Haus Mass. Inst. of Tech.	Picosecond Optical Signal Sampling Device	$38,500	9/1/80 12 months	19
Michael C. Hou University of Washington	Evaluation of Mudflow Damages to Toutle River by Photogrammetry	$10,114	7/1/80 6 months	19
Roger E. Kaufman George Washington University	KINSYN III-D	$122,316	12/15/79 24 months	19
Chandra P. Khattak Crystal Systems, Inc.	Growth of Laser Crystals by the Heat Exchanger Method	$210,000	10/1/80 24 months	19
Paul C. Lauterbur SUNY-Stony Brook	Nuclear Magnetic Resonance Microscopy	$53,921	9/1/80 18 months	19
Thomas J. Mahar Northwestern University	Approximate Solution of Nonlinear Problems in Applied Mathematics	$16,259	6/15/80 36 months	20
Julian D. Maynard Pennsylvania State University	Fifth Sound Superfluid Gyroscope	$134,000	3/1/80 36 months	20
E. R. Menzel Texas Tech University	Development of Fingerprints by Laser	$84,940	9/15/80 36 months	20
Frederic R. Morgenthaler Mass. Inst. of Tech.	Microwave Signal Processing with Coherent Magnetic Waves	$118,883	9/15/80 36 months	20
Arthur S. Obermayer Moleculon Res. Corp.	Poroplastic Personnel Vapor Monitoring Badges	$110,925	3/1/80 12 months	20
W. Rostoker Univ. of Illinois-Chicago Cir.	Study of Family of CR-Free, Rust-Resistant and Oxidation-Resistant Steels	$159,616	3/15/80 36 months	21
Sol I Rubinow Cornell University	A Mathematical Investigation of Reaction-Diffusion Systems Arising in Biology and Chemistry	$41,670	5/1/80 36 months	21
Henry G. Rylander University of Texas-Austin	Study of Homopolar Pulse Resistance Welding Parameters for Railroad Rails and Automotive Parts	$50,000	3/15/80 18 months	21
Gary L. Sheldon Washington State University	Wear-Out Failure of Mechanical Equipment Operation in Mt. St. Helens' Ash	$7,500	6/15/80 12 months	21
Michael A. Streicher University of Delaware	The Relationship Between Corrosion of Stainless Alloys and Electrochemical Measurements	$25,000	7/1/80 12 months	21
Teh Fu Yen University of Southern Calif.	A Study of the Structure Parameters on the Carbonaceous Mesophase Formation for Coke and Graphite	$150,000	9/1/80 36 months	22

Principal Investigator/ Institution	*Title of Project*	*Amount*	*Effective Date/Award Duration*	*Page*
BIOLOGICAL AND ECOLOGICAL APPLICATIONS PROGRAM ELEMENT				
William P. Bemis University of Arizona	Breeding and Utilization of the Buffalo Gourd	$149,738	10/1/80 24 months	22
John B. Conway Washington State University	The Effect of Volcanic Ash from Mt. St. Helens on the Aquatic Ecosystem (Benthic Invertebrates) of the Palouse River	$7,500	6/15/80 12 months	22
Brian A. Croft Michigan State University	A Comparison of Herbivore, Predator, and Parasite Adaptations to Toxins	$100,000	11/1/80 24 months	23
Edward S. Deevey University of Florida	Vulnerability of Florida Watersheds to Ripartian Disturbance	$160,222	3/15/80 24 months	23
Arnold L. Demaine Massachusetts Inst. of Tech.	In Vitro Biosynthesis of Penicillin and Cephalosporin Antibiotics	$210,490	4/1/80 36 months	23
Robert L. Hamlin Ohio State University	Acute Effects of Inhalation of Volcano Dust in the Canine Model	$10,000	8/1/80 12 months	23
Melvin T. Huish Amer. Fisheries Society	Warmwater Streams Symposium	$5,000	8/1/80 12 months	24
R. E. Hungate University of California-Davis	Biochemistry and Genetics of Conversion of the Plant Polysccharides by Anaerobic Bacteria	$110,194	10/1/80 12 months	24
William N. Holmes Univ. of Calif.-Santa Barbara	Effects of Toxic Metabolites Derived from Ingested Petroleum on Some Hormonal Regulating Mechanisms in Seabirds	$79,466	9/15/80 36 months	24
Leonard Keay Washington University	Symposium on Animal and Plant Cell Culture and Their Applications; August 24-29, 1980; San Francisco, California	$4,000	6/1/80 6 months	24
Robert A. Kennedy Washington State University	Emergency Request for Funds to Study the Effects of Mount St. Helens' Ash on Plant and Crop	$7,510	6/15/80 12 months	24
Richard M. Koes Washington State University	Nutritional Diagnosis of Mt. St. Helens Ash Laden Forage	$9,957	7/1/80 6 months	25
Michael P. Levi NC State Univ. at Raleigh	Support for 11th Meeting of the International Research Group on Wood Preservation at Raleigh, NC	$3,000	3/1/80 6 months	25
John A. Menge Univ. of California-Riverside	The Effect of Vesicular-Arbuscular Mycorrhizae on Salt Tolerance of Tomato	$80,000	3/15/80 36 months	25
Robert A. Menzies Nova University	Patterns of Larval Dispersal of the Crustacean Panulirus Argus	$180,000	8/1/80 36 months	25
Bernard Miller Univ. of Mass.-Amherst Campus	Test of a Process for Preparing Noncarcinogenic Food Dyes 24 months	$103,610	9/1/80	25
Roger A. Morse Cornell University	Biology and Control of Varroa Jacobsoni an Important Parasitic Mite of Honey Bees	$44,205	3/15/80 22 months	26
Douglas M. Munnecke Univ. of Okla.-Norman Campus	Development of Microbial Enzymes for the Detoxification of Pesticides	$89,000	3/15/80 24 months	26
David Pimentel Cornell University	Applications of Ecological Population Dynamics to the Pesticide Resistance Problem to Reduce Environmental Risks	$124,980	3/1/80 36 months	26
John J. Sasner, Jr. Univ. of New Hampshire-Durham	Toxins from Cyanobacteria	$161,618	8/1/80 38 months	26
Ramon J. Seidler Oregon State University	A New Approach to the Detection and Enumeration of Coliforms in Drinking Water and Raw Water Supplies	$115,721	8/1/80 24 months	27
Ralph A. Slepecky Syracuse University	Studies on the Mechanism of Heat Resistance of Bacterial Spores	$96,756	3/15/80 36 months	27
Jon G. Stanley Univ. of Maine-Orono	Reproduction and Growth in Polyploid Fish and Oysters	$119,892	9/1/80 24 months	27
Loy E. Volkman Univ. of California-Berkeley	Assessment of the Infectivity of a Pesticidal Virus in Non-Target Hosts	$86,279	4/15/80 24 months	27
Eugene B. Welch University of Washington	Ashfall Effects on Nutrient Cycling in Moses Lake, Washington	$7,419	7/1/80 12 months	28
Robert C. Wissmar University of Washington	Optimal Management of Chum Salmon Based on Estuarine and Nearshore Carrying for Outmigrating Juveniles in Hood Canal	$14,480	10/1/80 12 months	28
John Wormuth Texas A&M University	A Study of Feeding Relationships in Tuna and Porpoise Through the Application of Cephalopod Beak Analysis	$15,802	4/1/80 24 months	28
Rau Wu Cornell University	Synthesis of Novel Genes Coding for Lysine- and Tryptophan-Rich Proteins	$100,000	3/15/80 24 months	28
GEOPHYSICAL AND ENVIRONMENTAL APPLICATIONS PROGRAM ELEMENT				
Frank T. Awbrey San Diego State University	Artificial Aggregating Systems for Tuna Purse Seining	$123,216	5/12/80 12 months	29
J. R. Bell Oregon State University	Effects of Weathering on Geotechnical Properties of Mt. St. Helens Ash — Baseline Study	$10,519	8/1/80 12 months	29

Principal Investigator/ Institution	*Title of Project*	*Amount*	*Effective Date/Award Duration*	*I*
James C. Conti Bioresearch Inc.	Optimization of a Sensor for Ore Beneficiation Processes	$92,971	3/1/80 18 months	29
William C. Ghiorse Cornell University	Microbial Polymers and the Accumulation of Metals in Aquatic Environments	$133,439	3/15/80 36 months	29
Larry A. Haskin Washington University	Separation of Metals by Electrochemical Reduction in Molten Silicate Rocks and Slags	$159,215	3/15/80 36 months	30
Stephen E. Kesler University of Michigan	Evaluation of Secondary Gas Haloes as a Method of Deep Exploration	$59,789	8/1/80 18 months	30
Ronald W. Klusman Colorado School of Mines	A Comparison of Gas Techniques Useful in Geochemical Exploration and Analysis of Time Variation in Gas Emission	$23,575	8/1/80 15 months	30
Amos M. Nur Stanford University	Application of Rock Physics to Borehold Studies	$93,180	10/1/80 18 months	30
Thomas J. O'Keefe Univ. of Missouri-Rolla	The Role of Trace Elements and Additives in Non-Ferrous Electrolytic Processing	$11,992	9/1/80 12 months	31

GROWTH, INCOME AND EMPLOYMENT

Principal Investigator/ Institution	*Title of Project*	*Amount*	*Effective Date/Award Duration*	*I*
James J. Heckman Nat'l Opinion Res.	Racial Wages & Employment in South Carolina Industrial Labor Markets 1910-1978	$163,139	4/1/80 18 months	32
Allan H. Meltzer Carnegie-Mellon	Carnegie-Rochester Conference on Public Policy	$100,015	9/1/80 24 months	33

REGULATION RESEARCH

Principal Investigator/ Institution	*Title of Project*	*Amount*	*Effective Date/Award Duration*	*I*
Jan P. Acton Rand Corporation	Regulatory and Distributional Consequences of Alternative Electricity Rates	$128,765	8/15/80 24 months	33
Frederick G. Bailey Univ. of California-SD	Limited Entry and the American Fisherman: A Case Study of the Bristol Bay, Alaska Salmon Fishery	$83,432	4/1/80 18 months	34
George J. Benston University of Rochester	The Relation Between Mortgage Demand and Neighborhood Characteristics	$120,000	5/15/80 18 months	34
Laurits R. Christensen	An Assessment of the Change in Economic Efficiency Resulting from Deregulation of the U.S. Air Transport Industry	$190,000	3/15/80 36 months	34
Steven R. Cox Arizona State	The Market Effects of Lawyer Advertising	$180,000	4/1/80 28 months	34
Dennis N. Epple Carnegie-Mellon	Helium Conservation and Public Policy	$68,442	7/1/80 18 months	35
Michael Grossman NBER	Economic and Other Factors in Youth Smoking	$150,780	10/15/80 24 months	35
Henry D. Jacoby Mass. Inst. of Tech.	Cartel Behavior and Exhaustible Resource Supply: A Case Study of the World Oil Market	$149,922	8/15/80 24 months	35
Wesley A. Magat Duke University	Conference on Managing the Transition to Deregulation	$12,000	4/1/80 6 months	35
H. L. Ross SUNY-Buffalo Baldy Center for Law & Social Policy	Alternative Models of Regulatory Enforcement in Housing	$67,581	9/15/80 12 months	36
Oliver E. Williamson University of Pennsylvania	Antitrust Economics: The Transaction Cost Approach	$109,600	7/1/80 36 months	36
Louis L. Wilde California Inst. of Technology	Intervening in Markets on the Basis of Imperfect Information: An Information Theoretic Approach	$64,528	10/1/80 12 months	36

TELECOMMUNICATIONS RESEARCH

Principal Investigator/ Institution	*Title of Project*	*Amount*	*Effective Date/Award Duration*	*I*
John T. Carey New York University	Teletext for Public Telecommunications Services	$200,000	4/1/80 24 months	37
Barry G. Cole University of Pennslyvania	Ninth Annual Telecommunications Policy Research Conference	$17,000	10/1/80 9 months	37
Bridger M. Mitchell Rand Corporation	Pricing of Local Telephone Service — Phase II	$199,527	10/1/80 24 months	38
Roman V. Mrozinski National Aca. Sciences	Board on Telecommunications Computer Applications	$20,000	7/1/80 12 months	38
Michael D. Wirth University of Denver	Demand for Pay Television and Its Impact on Expansion of Cable Availability	$46,560	4/1/80 12 months	38

Principal Investigator/ Institution	*Title of Project*	*Amount*	*Effective Date/Award Duration*	*Page*
	PRODUCTION RESEARCH AND TECHNOLOGY			
Robert C. Bolles SRI International	Construction of Simple 3-Dimensional Computer Part Models Based on Visual Range and Intensity Data for Locating Industrial Parts	$134,990	3/15/80 24 months	39
Nathan H. Cook Massachusetts Inst. of Tech.	Computerized System for the Manufacture of Small Parts	$157,000	1/1/80 24 months	39
Thomas L. De Fazio Charles S. Draper Lab., Inc.	Feedback in Robotics for Assembly and Manufacturing	$200,000	4/1/80 24 months	39
David Dornfield Univ. of California-Berkeley	Tool Wear Sensing Via Acoustic Emission Analysis	$87,490	11/1/79 24 months	39
Uziel Landau Case Western Res. Univ.	Micro Electrochemical Patterning of Surfaces with Applications to Fabrication of Holographic Optical Elements	$169,500	5/15/80 24 months	40
William L. Maxwell Cornell University	Automated Factory Control	$53,036	10/1/80 12 months	40
Sudhakar M. Pandit Mich. Technological Univ.	Stochastic Modeling of the EDM Process with a View to Off-Line Optimization	$113,986	12/1/79 24 months	40
Donald W. Sweeney Purdue University	Infrared Holographic Optical Elements with Applications to Laser Material Processing	$178,239	5/15/80 24 months	41
	SMALL BUSINESS RESEARCH			
Richard A. Altes Orincon Corporation	Detection and Identification of Fish Schools form Sonar Echoes	$24,639	9/1/80 6 months	42
Terry M. and Sari K. Astro	Commerical Potential of Sex Reversal on Hybrid Tilapia	$22,486	9/1/80 6 months	43
Walter C. Babcock Bend Research Inc.	Waste Pond Treatment with Immobilized Liquid Ion Exchangers	$25,000	9/1/80 6 months	43
Robert Baron Energy & Environmental Engr.	Investigation of In-Situ Gelation to Control Emissions from Abandoned Hazardous Waste Sites	$24,856	9/1/80 6 months	43
Douglas Bilodeau Artech Corporation	Improvement of the Transverse Strength of Graphite Aluminum Composites by Hybridization with Sic Whiskers	$24,305	9/1/80 6 months	43
William Hugh Bollinger Native Plants Inc.	A Mycorrhizal Inoculated Containerized Plant Growing System	$24,999	9/1/80 6 months	43
Joseph Carleone Dyna East Corporation	Numerical-Controlled Orbital Forging Processes	$25,000	9/1/80 6 months	44
George E. Cook Merrick Corporation	Research on Adaptive Arc Tracking for Welding	$25,000	9/1/80 6 months	44
Robert T. Crow App Forecasting & Anal Inc.	Supply-Oriented Regional Macroeconomic Forecasting Model	$24,635	9/1/80 6 months	44
James R. De Haan Ionex Research Corp.	Alternative Silver Zeolite Concepts	$25,000	9/1/80 6 months	44
James A. Downing Zycor, Inc.	Interpolation of N-Dimensional Geophysical Data	$22,566	9/1/80 6 months	44
Ronald S. Gordon Ceramatec Inc.	Electrorefining of Sodium Using Solid State Rapid Ion Conductors	$24,494	9/1/80 6 months	44
Lloyd E. Hackman Ribbon Technology Corp.	Thin Steel Sheet Made from Melt Extracted Flake	$24,422	9/1/80 6 months	45
Clinton S. Hartmann R. F. Monolithics Inc.	Theoretical Modeling of an Innovative Unidirectional Surface Acoustic Wave Transducer	$24,030	9/1/80 6 months	45
B. P. Hildebrand Spectron Develop. Labs Inc.	Near Surface Flaw Detection by Ultrasonic Critical Angle Imaging	$24,723	9/1/80 6 months	45
Edwin Hoffman Osborne-Hoffman Inc.	Advanced Underwater Telemetry and Voice Links for Inland and Coastal Waters Research	$25,000	9/1/80 6 months	45
Waylon V. House Intermagnetics Genl. Corp.	Feasibility Study — NMR Imaging Microscope	$23,900	9/1/80 6 months	45
Stephen L. Kerrin Energy Resources Co. Inc.	Halocarbon Emulsion as Safe and Effective	$20,858	9/1/80 6 months	46
William J. Kerth Taylor Systems Engr. Inc.	Adaptive Welding System	$24,849	9/1/80 6 months	46
Henry P. Kirchner Ceramic Finishing Company	Toughened Ceramic Adhesives for Structural Ceramics	$24,917	9/1/80 6 months	46
David S. Mahler KLD Associates Inc.	Acoustic Concept for Measuring Particle Size Distributions	$25,000	9/1/80 6 months	46

Principal Investigator/ Institution	*Title of Project*	*Amount*	*Effective Date/Award Duration*	*Page*
George C. Matthiessen Ocean Pond Corporation	Enrichment of a Brackish Water Pond for Shellfish Culture	$18,000	9/1/80 6 months	46
James H. McAlear EMV Associates Inc.	Electron Beam Lithography of Protein Monolayer, Ultrathin Composite Resist Films	$24,305	9/1/80 6 months	47
John T. McConville Anthropology Res. Proj. Inc.	An Anthropometric Data Base for Commercial Design Applications	$23,895	9/1/80 6 months	47
Daniel C. Nelson Fiber Materials Inc.	Investigation of the Super Plastic Drawing of Acrylic Fibers	$23,900	9/1/80 6 months	47
J. P. Pemsler Castle Technology Corp.	Electrorefining of Aluminum	$25,000	9/1/80 6 months	47
Kenneth H. Purser General Ionex Corp.	Research on the Feasibility of a Multi-Channel Ultra-sensitive Analyzer for Mineral Resources	$25,000	9/1/80 6 months	48
Robert E. Schwall Intermagnetics Genl. Corp.	Hydrostatic Extrusion of In-Situ Process Superconductive Wire for Use in NRM Magnets	$23,900	9/1/80 6 months	48
Nate Shafer Pacific Ocean Farms Ltd.	Off-Shore Abalone Farm Research Project	$25,000	9/1/80 6 months	48
Douglas Shaw Hazen Research Inc.	By-Product Molybdenum Recovery	$24,900	9/1/80 6 months	48
Leonard M. Smithline Lansing Research Corp.	Research on Acoustooptic Filter Side Lobe Supression	$24,829	9/1/80 6 months	48
T. R. Sundaram T. S. Associates Inc.	Suspended Solids Removal Using Cross-Flow, In-depth Filtration	$25,000	9/1/80 6 months	49
Claudia D. Tesche Lutech Inc.	A Novel Superconducting Magnetometer with Quatum Noise Limited Sensitivity and Enhanced Coupling Properties	$24,472	9/1/80 6 months	49

RESEARCH INITIATION GRANTS

Ben Bernanke Stanford University	Credit Rationing, Liquidity and the Macroeconomy	$27,933	7/15/80 12 months	50
Rabis S. Bhagat University of Texas	Effects of Personal Life Stress Upon Individual Performance Effectiveness & Work Adjustment Processes Within Organizational Settings	$34,977	7/15/80 12 months	50
Donald W. Chamberlayne Worcester Polytec Inst.	A Composite Model for Mobility and Migration Analysis and Conditional Population Projections	$29,351	7/15/80 15 months	51
George Downs University of California-Davis	Modeling Municipal Response to Revenue Constraints	$34,893	7/15/80 24 months	51
R. D. Feltner Yale University	Stress and Life Transitions in Childhood: Parental Divorce	$34,999	7/15/80 18 months	51
Peter S. Fisher University of Iowa	Public Service Provision on the Urban Fringe: Alternative Institutions and the Patterns of Development	$34,952	7/15/80 13 months	51
Ronald C. Fisher Michigan State University	Effect of Tax Subsidies on Subnat'l Fiscal Behavior	$29,042	7/15/80 14 months	52
Daniel M. Geller Georgetown University	Adaptation to and Evaluation of Visual Features in the Urban Environment	$32,649	7/15/80 18 months	52
Craig S. Hakkio Northwestern University	Risk Premiums, Innovations and Multiple Currencies in the Foreign Exchange Market	$34,983	7/15/80 24 months	52
Kenji Hakuta Yale University	Bilingualism, Cognitive Flexibility and Social-Cognitive Skills in Children	$35,000	7/15/80 15 months	52
Linda Heath University of Minnesota	A Multi-Methodological Investigation of The Impact of Media on Perceptions of Crime	$35,000	7/15/80 14 months	52
Robert J. Hodrick Carnegie-Mellon	The Forward Foreign Exchange Market: Some Econometric Tests of Market Efficiency	$26,358	7/15/80 6 months	53
Richard C. Hula University of Maryland	Housing, Lending Institutions and Public Policy	$34,966	7/15/80 12 months	53
Kathleen C. Kirasic Old Dominion University	Spatial Cognition and Spatial Behavior in the Elderly: Implications for Learning New Spatial Environments	$31,360	7/15/80 24 months	53
James R. Larson Barnard College	Causes and Consequences of Supervisory Performance Feedback	$35,000	7/15/80 20 months	53
Carol R. Lowery University of Kentucky	Divorcing Parents: Decisions About Child Custody and Attitudes Toward Court Alternatives	$35,000	7/15/80 22 months	54
Mark E. McBride Tulane University	The Extent of Vertical Integration in the Oil Industry	$33,422	7/15/80 24 months	54
Edward P. Morgan Lehigh University	Local District Implementation of State School Finance Reform: Political and Economic Factors Affecting Educational Equity and Governance	$34,993	7/15/80 24 months	54

Principal Investigator/ Institution	*Title of Project*	*Amount*	*Effective Date/Award Duration*	*Page*
Michael G. Parkinson	Juror Reactions to Variations in Courtroom Speech	$33,038	7/15/80 24 months	54
John T. Scholz SUNY-Stonybrook	Corporate Regulatory Compliance	$34,949	7/15/80 12 months	55
Dale H. Schunk University of Houston	Development of Children's Arithmetic Self-Efficacy: The Roles of Overt Verbalization and Goal Setting	$22,703	7/15/80 12 months	55
Michael H. Schuster Syracuse University	An Assessment of Union-Management Cooperation and Its Impact on Productivity, Employment, and Other Indices of Organizational Effectiveness	$34,973	7/15/80 18 months	55
James H. Seroka Southern Illinois University	The Administration of Public Policy Decisions in Rural County Government Institutions	$33,839	7/15/80 23 months	56
Marybeth Shinn New York University	Staff Burnout and Turnover in Child Care Agencies: Job Stress, Psychological Strain, and Coping Responses	$34,941	7/15/80 12 months	56
Robin C. Sickles University of Pennsylvania	Estimation of Specific Factor Productivity and Efficiency for the U.S. Airlines: 1968-1979	$35,000	7/15/80 24 months	56
Gary F. Soldow CUNY-Baruch College	An Experimental Study Testing the Effects of Cognitive Developmental Stage on Children's Perceptions of Product Packaging	$34,758	7/15/80	56
Stephen A. Stumpf New York University	Exploration and Evaluation — Choice in Judgmental Decision-Making	$34,995	7/15/80 12 months	57
Robert F. Szafran University of Iowa	The Organizational Context of Sex Discrimination in Universities and Colleges	$35,000	7/15/80 22 months	57
Kenneth R. Vogel SUNY-Buffalo	Control of Externality — The Case of Trespass Laws	$34,134	7/15/80	57
Richard A. Weatherley University of Washington	Interagency Coordination for Client Processing: A Study of The Implementation and Impact of the Washington State Involuntary Treatment Act	$34,936	7/15/80 14 months	57
Michael J. White	Comparisons of Cognitive Map Accuracy and Affective State	$33,808	7/15/80 12 months	58
John F. Witte	The Classification and Politics of Tax Expenditures	$34,967	7/15/80 24 months	58
Philip K. Young Pace University	A Socio-economic Analysis of Ethnic Enterprise	$29,247	7/15/80	58
George Zodrow Rice University	Optimal Tax Reform: Dynamic Aspects of Implementation	$32,294	7/15/80	58

Note: Data for this report were taken from program records and therefore may differ from official National Science Foundation source documents such as TAB A to the Budget and Part II of the Annual Report which are generated from the Management Information System data base and which may contain different inclusions/exclusions.

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